

# ARCHIVES

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#### ON THE MANUFACTURE OF GLASS.

One of the articles, for which the United States ought no longer to be dependent on Europe, is GLASS. Our country abounds with the materials for this substance, so extensively necessary to our domestic wants, and in the daily business of our lives. With the view of assisting those who are disposed to engage in this Manufacture, the following paper is inserted. It is taken from Nicholson's Chemical Dictionary,\* and the notes from a similar work, by Messrs. A. & C. R. Aikin. The latter have entered minutely into the details of the manufacture, but these could not be given on the present occasion,

EDITOR.

**MOST** of the glasses, made for direct use, consist of an earthy substance called the basis, and a saline or metallic substance called the flux. The basis is usually siliceous earth, the salt an alkali, and the metal lead. But various admixtures of earth and metallic oxides, are used in the actual practice of the art. None of the acids, except the phosphoric, are sufficiently fixed to withstand the heat required to form the vitreous combination with an earth; and this salt has not yet been afforded cheap

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“ “ 1807, 2 vols. 4to.

enough to be used, except in assays by the blowpipe. The fluxes in glass-making are useful, not only because more fusible than the earthy matter, to which they communicate the same property, but likewise as solvents which combine with it in the dry way, and in some instances produce a compound possessing greater fusibility than belonged to any of the ingredients.

Mr. Loysel, who was well acquainted with all the processes of the art adopted in France, and at the same time a man of science, has published a very full and able work on the subject.\* He observes :

Vitrification, such as takes place in the large way, demands two principal conditions : 1. A furnace constructed of substances capable of resisting the action of a violent and long-continued fire, and vessels capable of containing the vitrifiable matter in fusion without becoming fused themselves. 2. Substances which have the property of forming by means of fire a solid glass, suitable to the object of the manufactory.

*Of the Furnaces and Crucibles.*—The matter employed for the construction of the furnaces and crucibles, must be of such a nature, as to take and preserve the forms required for the operations of the glass-house. Clay possesses this property in the highest degree ; for which reason, though grit-stone is used in some glass-houses, and a mixture of quartz and silex with clay, for the construction of furnaces, it has nevertheless been almost generally adopted for the construction of furnaces, and exclusively for that of the vessels.

Pure clay cannot be fused by any degree of heat yet known, unless what is excited by oxygen gas ; but the mixture of other earths, and particularly calcareous earth, causes it to enter into fusion, though itself alone is infusible.

The property of resisting the most extreme heat, is more or less altered in clay, by the admixtures it may contain. Sand, quartz, and mica, do not prevent a clay from being proper for the use of the glass-house, provided they do not too greatly diminish

\* Art de la Verrerie.

its ductility : but the same observation does not apply to bituminous matters, calcareous earth, gypsum, pyrites, or the metallie oxides ; for these substances render it more or less fusible.

The whitest clay is generally said to be the most refractory ; but whiteness is a very equivocal character, because it may consist with a large addition of calcareous earth. Now this earth is hurtful, not only because it renders the clay fusible, but because it forms pores in the crucibles by the swelling it occasions, when its carbonic acid is disengaged by the heat. A twentieth part of calcareous earth simply renders the compound less dense than clay alone, when exposed to the fire of the glass-house ; but a tenth part renders it sensibly porous.

The choice of a clay in a glass manufactory is of so much the greater consequence, as a failure in this article is attended with a loss of all the expenses in fabrication.

The clay to be preferred for this use ought to possess the following qualities : 1. It must be so refractory, as not to vitrify, or even perceptibly change its figure, by the heat of the furnace. 2. It must be ductile enough to receive and retain the requisite forms.

With regard to the refractory quality Mr. Loysel proposes three proofs. In the first, after having reduced the clay into small particles, and separated such foreign matters as can be distinguished, the application of a mineral acid will show whether it effervesce. If it do, there is reason to reject it ; but it may be easily seen, that this proof is uncertain.

The second proof consists in working the clay into a paste with water. Of this paste, several prismatic rods and some very thin crucibles of five or six inches in diameter, and the same height, are to be made. These, after being gently dried, are to be exposed five or six days in the furnace of the glass-house. The rods must be suspended by their extremities on two supports. When these are taken out, they must be put into the annealing furnace, and cooled by insensible degrees. If the rods have not bended, if the crucibles have preserved their figure, and if no cavities be perceived upon breaking them, the clay may be judged to be good.

The third proof, which he prefers to the others, consists in judging the refractory quality of the clay by the action of an alkali upon it. For this purpose, it is mixed with different doses of fixed alkali, in crucibles of the same earth, or any other of known goodness, and a comparison is made of the proportion necessary to effect a complete vitrification with that which produces the same effect in a refractory sand exposed to the same degree of fire. Mr. Loysel has found, that if eight ounces of alkali be required to vitrify one pound of the sand of Aumont, near Senlis, and ten ounces of the same alkali to produce the same effect, in a like degree of fire, upon a pound of baked clay, this clay may be employed in the construction of furnaces, and crucibles not intended to undergo a more violent heat than that of the proof, provided its firmness and tenacity be likewise sufficient.

The essay of clays, with regard to their tenacity, forms the second object. The solidity of works constructed with clay depends on the force of the cohesion of its parts. This force, when the work has been dried by degrees to a temperature of 25 or 30 degrees of Reaumur, which correspond with the 88th and 107th degrees of Fahrenheit, is so much the greater in proportion to the ductility of clay when in the state of paste; so that both these qualities may be confounded with the tenacity of the clay. But this tenacity is extremely variable. Sand diminishes it more than any other foreign admixture.

All the parts of the furnace of fusion do not require the same tenacity. The thicker parts require many cavities for the dissipation of the moisture; but the crucibles demand a compact and tenacious clay, to resist the fluxes, and oppose the pressure of the glass they are to contain. It is of importance therefore to determine the degree of tenacity suitable to each object. Of the different methods tried by Mr. Loysel, the following succeeded the best.

He forms with the clay intended to be tried, small four-sided rods, which he leaves to dry at the temperature of 25 degrees of Reaumur [ $88\frac{2}{10}$  Fah.]: He then fashions them, and reduces one

of their extremities to a dimension of six lines in each of its four sides. He inserts this extremity into a cubical cavity, and at the distance of eighteen lines he places the knife edge of a balance, into the basin of which he pours sand, until a fracture takes place in that part which is only six lines thick ; and from the weight of the balance, the sand, and the broken pieces, he estimates the tenacity of the clay. To avoid accidental irregularities, he repeats the experiment with several of these rods. Hence, he finds, that his constructions are solid, when the tenacity of the clay, prepared for the walls and the arched roof of the furnace of fusion of eight feet diameter, is such, as to resist about twenty-four ounces applied as here described ; and for crucibles of three feet in diameter, and three inches and a half thick in the lower part, when it resists fifty-six ounces. But the degrees of tenacity, which may be usefully applied, have limits of considerable extent, and may likewise be changed according to the dimensions of the articles. Thus the resistance of a crucible may be increased by adding to its thickness.

When it is known by experience what are the thickness and tenacity of clay, suitable for vessels of a certain dimension, it is easy to determine by computation for other dimensions. Mr. Loysel has given a table for this—the thickness of the lower part of the pots, where the pressure is greatest, whence the thickness diminishes to the rim. At this part, though the pressure vanishes, it is nevertheless necessary, that a certain thickness should be given, that it may dry with regularity, and resist such occasional slight blows as the vessel is likely to receive.

For the most part it is not usual to employ native clay, because it retains moisture very obstinately, is apt to crack, and adheres strongly to the moulds. To remedy this inconvenience, its tenacity is diminished, and its porosity increased, by a mixture either of sand or of baked clay, which is reduced into powder, and improperly called cement. The old crucibles, after a careful separation of such glassy matter as may adhere to them, are used for this purpose ; but as these do not furnish a sufficient quantity, other parcels of clay are baked expressly for this use.

Sand greatly diminishes the tenacity, and is most strongly attacked by alkalis. For this reason it is used only in constructions of moderate thickness, the respective parts of which require only a moderate degree of tenacity to support themselves. Such are the walls of the furnace of fusion; but cement is used for several other parts of the furnace, and more especially for the pots.

Glass manufacturers differ in their opinions as to the degree of fineness proper to be given to the cement; but it is easily seen, that, if the cement be more grossly powdered, the paste will be less homogeneous, more disposed to contract irregularly, and to acquire vacuities into which the fluxes will insinuate themselves. It is requisite, therefore, that the cement be reduced to a fine powder, for which purpose it must be passed through very close sieves of silk.

If the tenacity of a mixture of clay and a given quantity of cement be determined, it will be easy to ascertain that of another mixture; for the tenacity of the first mixture will be to that of the second, in the same proportion as the quantity of clay: and the proportional tenacities of mixtures, determined at a certain degree of heat, continue to be preserved very nearly at every other degree of heat, provided the tenacity of the clay made use of in both mixtures were originally equal.

The contraction which clay undergoes in the fire is subject to great variation in different kinds, and deserves particular attention. Such clays as contract very much, retain water with more force, and are less easily dried; they support the alternations of heat and cold more difficultly; become filled with cracks and clefts, through which the fusible matters penetrate, and appear on the outside in vitrified exsudations. This last inconvenience is more particularly to be feared in those glass works where the pots remain uncovered, as is the case where wood, and not pit-coal, is the fuel. For then the glass which drops from the roof mixes with the vitrified matter, and produces tears and veins.

Cement and sand diminish the contraction of clay, in proportion to their quantity; but at the same time they diminish its

tenacity, and by rendering it more porous, cause it to be more easily vitrified by the fluxes.

The master of the glass work must determine what mixture is most suitable to his undertaking, by combining these different properties. If he use covered vessels, he may employ a much greater proportion of sand or cement in the roof of his furnace. There are some who prefer sand to cement; but a distinction must be made as to the degree of fusibility in the clay-made use of; for if the cement have more fusibility than the sand, as will happen with clays of middling quality, the sand should then undoubtedly be preferred: but with a good clay, the cement is certainly best.

*Concerning the Construction of the Furnaces for Fusion.*—

There are three methods of constructing the furnace of fusion in a glass-house. 1. By using soft bricks. 2. By using bricks dried at the ordinary temperature of the atmosphere. And 3. By using bricks baked in the usual heat of a brick-kiln.

The soft bricks are made as follows: The clay is first dried, and the foreign matters which can be discerned are taken out, for which purpose the pieces must be broken, and examined within. If the clay contain much pyrites, the earth is mixed with water, in such a quantity, that the mass may be passed through the common sieve of the mealman. The larger pyrites remain behind, and those which come through subside to the bottom with the coarser sand. The mixture is then left to rest, the earth gradually subsides, and the water is from time to time drawn off, by cocks at different heights in the side of the vessel, until the mixture is sufficiently thick to be worked up with the sand or cement. This operation lasts between two and three months; at the end of which time, the matter, rejecting the inferior or lower part, is mixed with the sand or cement into a proper paste. If the clay do not contain pyrites, it is ground without water in a mill under a millstone of grit, then sifted and mixed with the sand or cement. Water is then added, to convert the whole into a paste; or otherwise the clay purified by the first process of examination is soaked with water for four-and-twenty hours, and mixed with sand or cement.

In whatever manner the paste may have been prepared, it must be of such a consistence, that a ball of lead weighing four ounces, may bury itself the depth of its diameter, when let fall out of the hand from a height not less than twenty-four inches, nor more than forty-five.

In this state the bricks would be too soft for the construction of a furnace, and would contract too much in drying. It is necessary therefore, that they be left to dry upon planks of wood. The firmer they are, the better for use, provided they do not break under the mallet of the workman, who strikes them with all his force to unite the different courses together, and to give them the figure required in the different parts of the arch-work. In this state, a ball of lead of four ounces will require not less than a height of twenty-five feet, nor more than thirty-five, to bury itself half its diameter in the clay; but a consideration of importance is, that all the bricks ought to be sensibly of the same consistence, in order that the contraction of the different parts of the furnace may be as equal as possible.

This method of construction is the best which is known in the glass works. It is attended with the fewest cracks, and endures the longest. It is particularly advantageous in the manufactories of fine glass, and those wherein the vessels are uncovered. Nevertheless it is used only in great establishments. The reason is, that this construction requires more care, time, and expense than any other. It requires likewise a building, in which there are no other furnaces at work, in order that the drying may not be too hasty.

The construction with bricks dried in the air, or baked in the ordinary method, has nothing peculiar in it. This method of building ought to be reserved for glass works where the pots are covered, or for common glass. And even in these, the first method would be found the most advantageous, if the necessary capital be not wanted.

*Concerning the Fabrication of the Vessels or Crucibles.*—The paste or mixture of clay and cement is prepared in the same manner as for the bricks already described, with this difference only,

that it must be more consistent. A ball of lead of four ounces weight ought not to fall from a less height than sixty-five inches, nor a greater than eighty-three, to bury itself beneath the surface.

There are two methods of making pots for the glass-house. In the first, a mould of wood is made use of, lined within with a strong and well stretched cloth, and rolls of the paste are applied successively one above the other. In the second method a potter conducts his work without a mould, and joins the rolls of clay together by pressing them strongly between his hands. This second method is considered as better and more exact than the first.

The drying of the pots must be effected in the shade, in a place defended from currents of air, in a temperature between  $55^{\circ}$  and  $65^{\circ}$  of Fahrenheit. The drying must be slow, in order that the contraction may be regular.<sup>a</sup> It is likewise requisite to defend them from frost and dampness. For this purpose, when the pots begin to dry, they are put into a close place, where the heat is gradually raised to  $90^{\circ}$  or  $100^{\circ}$ . They are then conveyed into the annealing furnace, where they are gradually heated to ignition: after which they are put into the melting furnace, heated less than its usual rate. The fire is successively raised to its greatest degree of heat. In large works, this diminution of the heat lasts three or four hours; but this time is not sufficient to effect a complete drying, for pots of large dimensions. These are usually left empty during the first working of the other pots.

*Concerning the Heat of the Furnaces of a Glass-house.*—The heat is greater the larger the quantity of air consumed. The entrance of the furnace ought to be therefore entirely free for the access of air; and the vapours of the furnace, which consist in a great measure of air unfit to maintain combustion, ought to be carried off as much as possible. Hence it follows, that the method employed in glass-works where pit-coal is the fuel, and in a few others where wood is used, deserves approbation. It consists in establishing a current of air through one or more arched passages, commonly under ground, one of the extremities abutting at the furnace, and the other being placed without the build-

ing which contains the furnace, and is commonly called the hall. By this means, several furnaces of fusion may be placed in succession in the same hall, without the combustion of the one being injurious to that of the other, as usually happens in less judicious arrangements. That disposition which approaches nearest to this is when the doors of the hall are opposite the furnaces; but the most injudicious is that which is commonly employed in glass-works where wood is burned. In this, the doors of the hall are on one side. The time required for the fusion and depuration may vary by the difference between the first and the last disposition from 18 to 34 hours.

The air ought to be heated before it arrives at the fire, that its temperature may be less remote from that wherein the combustion is effected. It ought therefore to pass through the ash-hole. Ordinarily in furnaces wherein wood is burned, the current is directed against a small dome above the ash-hole. It ought to be directed immediately into the furnace.

The interior part of the furnace cannot acquire its greatest degree of heat, but in proportion as that which is produced in the fire is deprived of the liberty of escaping during its disengagement. It is even necessary, that it should be distributed as equally as possible through the whole interior capacity of the furnace. Now this effect depends on the magnitude and position of the issues of the flame, and the interior figure of the furnace. It is easy to ascertain by experience in each particular case the proportion which ought to exist between the entrance of the air, and the escape of the flame, by making the apertures of that escape at first larger than necessary, and then diminishing them with moveable bricks disposed for this purpose, until the furnace appears to be in the greatest state of ignition.

The heat is greatest in those parts where the motion of the flame is the most rapid, and this is usual in the vicinity of those apertures to which it is naturally directed. The equality of the heat of the pots placed round the furnace, depends therefore on an equal distribution of the apertures round the same circumference.

The internal figure of the furnace likewise sensibly influences the motion of the flame, and consequently the degree of heat thence arising, as well as the equality of its distribution in the different parts of its capacity. The horizontal section of most of the glass-house furnaces, in France, is a square or rectangular parallelogram in the whole of the part occupied by the pots. Hence it arises, that the motion of the flame is checked in the vicinity of the pots placed in the angles; that the heat is less in those than in the other pots; and consequently that with equal mixtures of vitrifiable matter, the glass is not so well refined in the same time as in the other pots, and a greater degree of heat must be used to accomplish this purpose. This produces, 1. a greater expense of fuel; 2. the vitrification and destruction of the dome by excess of heat; and 3. the dome being very much heated, it is necessary that the fire should be slackened in order that the glass may clear itself before the work commences. Mr. Loysel therefore proposes, that the figure of the furnace should be changed, and that it should be formed of a continued curve line like the dome.

The vault or dome of the furnace is the part to which artists pay the greatest attention. Its figure is not the same in all glass-houses; but in a considerable number its generating curve more or less approaches the common parabola. Mr. Loysel proves from various considerations, that the spherical figure is more advantageous.<sup>b</sup>

Pit-coal and wood are equally capable of affording heat not only sufficient for vitrification, but even to alter the figure of the pots. The flame may be more or less charged with sooty matter, which is hurtful in all cases wherein the flame comes in contact with the glass. It colours the vitrifiable matter, and reduces the metallic oxides, if such enter into the composition. There are cases wherein the intensity of the heat and the purity of the flame are equally essential, as in the fabrication of glass where the manipulations require the pots to be uncovered. In other cases the intensity of the heat is the principle condition, as in the glass-works where the pots are covered. In other circumstances,

again, the purity of the flame requires the utmost consideration, as in the calcination of the frit.

If the colour of the glass be a matter of no consequence, pit-coal may be used for all the operations, provided that the metallic oxide do not enter into the composition; but if an equally quick fusion be required, with similar doses of fluxing-matter in covered as in uncovered pots, a greater heat must be applied, on account of the resistance opposed to the transmission of the heat by the cover.

Resinous woods afford more smoke than poplars, ash, &c; and these more than birch, oak, sycamore, and beech. The last three are the best for heating the melting furnaces; as well for the purity of the flame, as the intensity of the heat.

In order to obtain the greatest quantity of flame, and the least of smoke, the same quantity of fuel must be constantly kept on the fire. It must therefore be added in small quantities, and at frequent intervals.

*Of the Choice of Vitriifiable Earth.*—The whitest sand is the most frequently mixed with other earthy substances. To clear it of these, it is washed with agitation in clean water. The earthy parts, which are lighter than the sand, remain suspended in the water, which is decanted off, and fresh parcels added, till it comes off clear. If it contain combustible matters capable of colouring the glass, it is ignited for the purpose of burning them off. This is the method of purifying the sand for fine glass.

*Of the metallic Oxides considered as Fluxes.*—Of all the metallic oxides, considered as fluxes of siliceous earth, those of lead are the most used; not only because they are capable of vitrifying a larger dose of this earth, but because they are less costly, and may be employed in considerable proportions without injuring the whiteness of the glass. Minium is preferred to any other oxide of lead. The greater proportion of oxide of lead which enters into a composition, the less brittle the glass proves by the alternations of heat and cold.<sup>c</sup> The more, on the other hand, the vitriifiable earth predominates, the glass will be more white, transparent, light, subject to break by sudden change of temperature,

and difficult to soften by heat. The proportions of oxide of lead and sand must therefore be varied according to the object desired.

*Concerning Arsenic.*—The use of arsenic is avoided in glasses which contain oxide of lead, because this material favours its sublimation. The most effectual, as well as the most common method, is to mix nitre along with the vitrifiable materials. A large dose of arsenic gives a milky appearance to glass, and may even render it entirely opaque. As glass is sometimes capable of being attacked by acids, it is proper to avoid arsenic in all vessels intended to contain liquors for drinking.

Arsenic mixed with coaly matter, and exposed to the fire, becomes violently inflamed and flies off. Advantage has been taken of this property: when it is perceived during the fusion, that the glass is coloured yellow for want of calcination, and that the mass is not sufficiently fluid, some manufacturers are in the habit of throwing pieces of arsenic into the pot. The arsenic takes away some of the colour from the glass, and by its inflammation and volatilization gives to the mass an internal movement, which facilitates its settling, and partly clears it of bubbles. But it is evident, that it is useful only as a remedy for preceding negligence. Mr. Loysel is of opinion, that arsenic may and ought to be banished from the glass-house.

*Concerning Saline Fluxes.*—The potash and soda employed as saline fluxes, vary considerably by the quantity of earth and neutral salt they contain. For common glasses the mere ashes are frequently used. In all cases trial is made in the small way of the best proportions of the sand and the alkali.

The neutral salts which are mixed with the alkali, are not only hurtful because they diminish the proportion of this last, but principally because they are incapable of combining with vitrifiable earth, and when mixed through the whole mass of the glass, they form a foreign opaque matter. In this state, the most active and long-continued heat would be scarcely sufficient to dissipate these salts. The most effectual remedy hitherto discovered, consists in diminishing the heat of the furnace when the time of complete fusion is past. The neutral salts, being specifically lighter,

rise to the surface, where they are taken off, and form what is called sandiver, salt of glass, or glass-gall; but this operation is attended with a loss of time, which is of prejudice, and some of the salt may remain in the manufacture. It is usually seen in the form of white flowers resembling flakes of snow. These kinds of glass are brittle, especially when part of the salt of glass is at the surface. It would therefore be a valuable operation, to deprive the alkalis of the neutral salts, with which they are mixed. Mr. Loysel avails himself, for the purification of potash, of its property of being much more abundantly soluble in water, than the neutral salts it may contain. One hundred pounds of the saturated solution of potash contain forty-eight or fifty pounds of alkali; and this solution makes forty-eight or fifty degrees on the areometer of Baumé. If the evaporation be carried on till the solution is concentrated to the fortieth degree, the greater part of the foreign salts separates, and what remains cannot injure the glass. This method adds very little to the expense, because the best manufacturers are in the practice of dissolving their potash, to separate its impurities.

During the fusion, the carbonic acid is disengaged from the alkali, and produces an effervescence, which renders it necessary to increase the number of fusions; adding but small quantities of the mixture at a time, in order that the elastic fluid may be at liberty to escape. By this means the time of fusion is prolonged. The inconveniencies of this effervescence are avoided by adding, as Mr. Loysel proposes, an equal weight of lime to the alkali, in the solution made for the last-mentioned purpose. This pure alkali is very deliquescent, but it may, without any inconvenience, be employed in the glass works immediately after its desiccation.

Pure alkali dissolves a quantity of vitrifiable earth, which is more considerable, the greater the intensity of the heat: so that the point of saturation depends on this circumstance. Whence it happens, that the glass made at different furnaces is more or less alkaline, and consequently more or less subject to decomposition. If the proportion be such, that the alkali in the glass is less than one fourth of its weight, the glass will be very solid:

but if the heat made use of be so feeble, that the point of saturation cannot be obtained but by the proportion of equal parts of these two ingredients, the glass, though clear and transparent, will be of so loose a composition, as to be attacked and dissolved by mere water.<sup>d</sup>

*Concerning Lime.*—Calcareous earth, renders the glass into which it enters less subject to attract moisture, and less brittle by changes of heat and cold. Its whiteness is not perceptibly altered; but in order to avoid the effervescence produced by the disengagement of carbonic acid, the common practice is to use lime. This practice is still more advantageous, because the combustible matters of the lime stone are burned by calcination; and the water, which is one of its component parts, is dissipated. This water, together with the carbonic acid, if volatilized in the furnace of fusion, would facilitate the escape of part of the alkali.

Vegetable earth, such as is obtained by lixiviation of the ashes of vegetables, is used only for the most ordinary glass, because it alters their clear white colour. As it is fusible alone, which lime is not, it might be employed in large doses, without fear of impeding the vitrification of the sand and alkali, if there were not cause to fear the destruction of the pots, which it very speedily corrodes. This property makes it necessary to limit its proportion to one pound for every two pounds of sand, and a sufficient quantity of alkali.

The lime demands for its vitrification a greater quantity of alkali than sand does; yet the doses of sand and alkali being determined for the vitrification, a good glass may be obtained by adding a certain quantity of lime. Whence it happens, that with the same quantity of flux, a larger quantity of glass is afforded, without considering the good qualities the lime communicates. Lime cannot, however, be used but with great moderation, because the glass, of which it is a part, vitrifies the clay of the pots, of which the preservation is an important object. From this consideration no more than ten or fifteen pounds of lime are added to one hundred pounds of alkali, and two hundred or two hundred and twenty pounds of vitrifiable earth.<sup>e</sup>

There is an easy remedy against the action of the glass containing calcareous earth upon the pots. It consists in adding to the composition of the glass a sufficient quantity of clay to effect a saturation. This is accordingly done in the manufacture of bottles. But as the clay used in the glass-houses always produces a green glass, it cannot be admitted in the composition of white glass.

A very remarkable effect of calcareous earth, and also of the vegetable earth, in vitrification, is the decomposition of the sulphuric salts with bases of fixed alkali, whatever may be the manner of their favouring the disengagement of the acid. Calcareous earth may be vitrified in the proportion of one part of the earth to three or four of salt, according to the degree of the fire. This property renders the use of lime and the vegetable earth very advantageous in the manufactories of common glasses, wherein the soda of kelp is used, which contains a considerable proportion of sulphat of soda.<sup>f</sup>

*Concerning the Substances proper to purify the Glass.*—The substances most advantageously employed in the purification of glass, are the oxide of arsenic, nitre, and the oxide of manganese. The first has been already mentioned.

Nitre serves as a flux, by virtue of its alkaline part, and may supply the place of alkali according to the proportion it contains; but its high price prevents its being employed for this purpose. It is with a view to destroy the coaly matters contained in the mixture that it is added, and accordingly it is never used but when the materials have not been sufficiently calcined.

It is likewise with the same view that the oxide of manganese is used. We are indebted to Scheele for a knowledge of the manner in which this oxide operates. Naturally it gives a violet red colour to glass; but when deprived of part of its oxygen by the combustion of coaly matter, it loses its colour, and leaves the glass white. Hence a notion may be formed of its effects when added to glass in different proportions. If the dose be too small, it does not destroy entirely the yellow colour produced by the coal of the ingredients not sufficiently calcined; if it be too large, it communicates its own peculiar tinge.

The oxide of manganese is capable of destroying such colours only as are produced by coaly matter: but not those which arise from metallic substances, such as iron, lead, and cobalt. In these cases it produces a mixed colour, from the combination of its own tinge, and that of the metal already in the glass.

If it be proposed to communicate to glass the colour of the oxide of manganese, the materials must be well calcined; and arsenic must not be used, as it would attract the oxygen of the oxide. Nitre will restore the colour if destroyed. It effects this by affording oxygen.

In some cases, when it is desirable to give a slight green tinge to glass, instead of the yellow colour produced by a metallic oxide, a small quantity of the oxide of cobalt is added, which gives a blue colour, and this, by mixture with the yellow, produces a green.

The oxide of manganese forms a glass specifically heavier than common glass; whence it arises, that the glass at the bottom of the pots in many glass works is violet. It is undoubted, that when this happens, the dose of manganese is too great. The usual method of remedying this inconvenience, is to stir up the glass with an iron bar, after previously raising the fire to render it more fluid. It is thought, that the manganese is in part dissipated by that means; but it is merely distributed through the mass. A more effectual remedy is to add some combustible substance to the glass, to destroy its colour; such as arsenic, charcoal, sulphur, &c.

*Concerning the Calcination of the vitrifiable matters.*—The calcination is an important preparation of the materials intended to be vitrified. Its chief effects are the dissipation of volatile substances, which ought not to enter as constituent parts of the glass, and the combustion of coaly matters, which without this operation never fail to colour the glass.

Two conditions are requisite to a perfect calcination: 1. the materials must present a large surface to the air; and 2. the heat to which they are exposed, ought not to be attended with the smoke of the fuel. The first condition demands, that the heat

should not be so violent as to produce fusion. And moreover, the heat should be gradually raised, to drive off the volatile matters, without raising along with them any part of those which are more fixed.

The sand made use of, is commonly more or less white in its natural state ; but it becomes still more so by calcination, and the glass is improved in consequence. The fire may be urged to the strongest degree, when sand is calcined by itself ; but a moderate heat is commonly used, unless when the very finest glass is intended to be made. In general the sand is subjected to no other calcination than that of the mixture of alkali, lime, &c., called the frit.

The calcination of the alkali is of the first importance. By this means the elastic fluid is driven off, which would disturb the fusion. Part of the evaporation of the salt, which takes place before it acts as a solvent to the sand, is thus prevented. And more particularly the coaly matters are burned, which it always retains notwithstanding any other previous depuration.

In the purification of alkalis all such vessels are to be avoided as might communicate colouring particles to them ; such as boilers of iron. Those of lead are preferable ; because, if any portions of the metal should be detached, no sensible inconvenience will arise as to the whiteness of the glass.

The heat must be more particularly attended to in the purification of the alkali, that it may be so moderate, as not to produce that liquefaction which is called the aqueous fusion, and arises from the water it contains. For this purpose the salt must be frequently turned, and not calcined in too great a quantity at a time.

The calcined fixed alkali may be preserved in its concrete form in apartments defended from moisture. The same precaution is not required for the lime and sand.

After the mixture of these three substances, the mixture may be subjected to vitrification in the pots of the furnace of fusion ; or it may be subjected to another calcination called the operation of the frit. If the mixture of vitrifiable matters be not

subjected to this operation, the other ingredients are likewise added at this period, whether they be nitre, arsenic, or oxide of manganese, for purifying the glass, or such metallic oxides as are intended to produce colour. But if the mixture be fritted, no other materials are now added but the oxides which are intended to possess the last state of oxidation.

*Concerning the Operation of the Frit.*—The operation of the frit answers two purposes. The first is to complete the combustion of the coaly matter, and the dissipation of volatile substances; the second, to incorporate the materials with each other by a beginning of that combination, which is perfected in the furnace of fusion.

When a mixture of very dry concrete alkali and sand is made, and immediately subjected to a heat sufficient for its vitrification, the alkali speedily enters into fusion; the sand, being more heavy than this fluid alkali, falls to the bottom of the vessel, and the supernatant alkali is in part evaporated before the whole of the sand can be dissolved. In this case the glass will contain unvitrified sand, notwithstanding a sufficient or even a superabundant proportion of alkali may have been used. This inconvenience is but too common in those works where the operation of the frit is not used; but it is avoided by that commencement of union which the sand, lime, and alkali, acquire in this operation, and which holds them together till the vitrification is completed.

The accurate mixture of the vitrifiable matters can alone produce the clearest glass, which is the properest to receive the several colours afforded by the metallic oxides. The frit is therefore an operation of advantage for coloured glasses, as it prevents the production of false or irregular tinges.

Vitrifiable matters newly fritted destroy and corrode the crucibles less than such as have not been so treated: 1. because they are exempt from humidity; and 2. because the alkali is no longer in a disengaged state.

When it is proposed to augment the density of a glass by means of a metallic oxide or glass, such as those of lead, the

glass produced will be more uniform in its texture, the more equally the combination has been effected through the whole of the mass. Now the commencement of combination, which is established between all the parts of the frit, prevents the oxide of lead from falling down as readily as it would otherwise do.

The operation of fritting is performed in one or more furnaces adjacent to the furnace of fusion which communicate with it, and to which the name of *arches à fritte* is given by the French; or otherwise it is done in separate furnaces. The former method is preferable, because the flame does not arrive at the frit until all the parts of the fuel have had time to be consumed; because they can more easily be kept at a steady and suitable heat without an additional expense of fuel, and because the vitrifiable matters may be immediately transferred in their white heat to the furnace of fusion. Hence the vitrification is more speedy, and the crucibles less injured, than if the materials were put in cold.<sup>s</sup>

*Concerning the Fusion of the vitrifiable matters.*—It is necessary to diminish the heat of the furnace at the time of working the glass, in order that it may assume consistence enough to be wrought; but as the ingredients required to be added from time to time occasion a refrigeration, the furnace is again heated before they are introduced. The time of reheating differs in different works: but it is ordinarily one or two hours for furnaces of six or seven feet in diameter.

The cold produced by this circumstance, being in proportion to the quantity added, it is clearly requisite not to add too much at a time; because too much cooling might even break the vessels. The pots are therefore filled at two, three, or four different intervals; and this is called making two, three, or four fusions, or fonts.

The second font must not succeed the first, until the preceding vitrification is completed. Two methods are used to ascertain this. The first consists in observing the end of the effervescence, and the dissipation of the alkali superabundant to the vitrification; which may be known by the tranquillity of the font. The

second consists in taking proof of the glass, after the cessation of the fumes arising from the evaporation of the alkali. If it be found, that the bubbles are dissipated, the second font may be made : and the same observation applies to the succeeding fonts.

The time employed in the vitrification is distinguished by the name of the time of fonding, and that employed in the dissipation of the bubbles, the settling or refining. The glass is said to be fine, or well refined, when it contains no more bubbles. If the second font were to be made before the glass of the first were well refined, the subsequent cooling would prevent the dissipation of the bubbles, at least during the whole time requisite to produce the original fluidity, and the subsequent refining would prove long and tedious. While the pots are thus supplied, the vents of the flame must necessarily be kept open, which cools the furnace also. For these reasons, it is proper to avoid either too few or too many fonts.

As soon as the glass is fine, the heat of the furnace is diminished by adding less fuel, or none at all, according to the nature of the work, whether of blown or of cast glass. By the diminution of heat, the glass becomes thicker or less fluid, and is fit for working. During the whole time of working the consistence must be the same : and for this reason, in the operation of blowing, of which the working may continue from five hours to twenty or more, according to the nature of the articles, the furnace must be kept at the same degree. But this need not be as intense as for the fonding and refining.

There are two methods in practice of conducting the fonding, refining, and working of glass. In the first, each operation is made at the same time in all the pots ; in the second, the fonding and refining are effected in one half of the pots, while the glass is worked in the others. It is easy to imagine, that the glass-works where this last practice prevails cannot have so intense a fire as the others. To supply this defect, a greater quantity of flux is used in the vitrification ; and the glass, containing less earth, is tender, and subject to be decomposed. Exception must however be made with regard to those glass-works in which no

other materials are used but old glass, or very fusible matters, such as lavas, basaltes, &c.

*Of the Annealing of Glass.*—Glasses of any considerable thickness, as for example, two or three lines, if suffered to cool in the open air immediately after being formed, suffer an unequal contraction from their surface on account of the inequality of their thickness. These glasses frequently break of themselves by change of temperature. They fly or break with some noise, when an attempt is made to cut them with a diamond, or to grind them on the wheel or other tool. The annealing is a remedy for this defect. It consists in passing the glass, slowly and by insensible degrees, from the state of ignition it possesses in the furnace of fusion to the temperature of the atmosphere. For this purpose, as soon as the work is finished, and has assumed consistence enough to retain its form, it is conveyed, while still at a red heat, into a furnace which has nearly the same heat as itself. There the cooling is effected in one of the two following ways: The annealing furnace, or leer, is filled with the manufactured articles, and kept at the same heat during the whole time of working, after which it is suffered to cool slowly together with its contents; or otherwise, one or several pieces newly made are gradually passed along the annealing furnace, by occasionally removing them from one end, which is hottest, to the other, where it is so slow that the pieces may thence be safely transferred into the open air.

The slowness of annealing varies according to the brittleness of the kind of glass, and the thickness of the work. Thus a glass made with flint and alkali alone, is more difficult to anneal than if it contained a metallic oxide or lime; and the first kind will always be more subject to break by alterations of heat and cold. The vessels to be annealed must be cool enough not to adhere to the support on which they are placed; for the inequality of contraction between them and the support might occasion them to break. The same accident happens to pieces made of glasses of different dispositions to contract. The contraction of the piece to be annealed is effected more easily, the less friction it has to

overcome : for which reason, when large plates of glass are to be annealed, the surface is placed on moveable bodies, such as grains of sand.<sup>a</sup>

*Concerning the principal Defects observable in Works made of Glass.*—The most considerable defects, as enumerated by Mr. Loysel, are striæ or veins, threads, tears, cords, bubbles, and knots.

The striæ or veins arise from the heterogeneous composition of the glass. It seldom happens, that glasses of any considerable magnitude are exempt from them, and the reason is not difficult to explain.

Glass produced by the solution of siliceous earth by fixed alkali, at the ordinary heat of the glass-house, possesses a specific gravity of 2·3 or 2·4, water being assumed as usual at one. Glass made with alkali, and the clay commonly used, weighs about 2·5. That of alkali and chalk, 2·7 or 2·8. The oxide of manganese vitrified alone weighs 3·2 or 3·3. Glasses produced by other metallic oxides are still more ponderous : that of lead, for example, weighs about 7·2 or 7·3. When the partial combinations of the ingredients of the glass are not well mixed together, but form strata of different density in the pots, they produce undulated veins in the work, similar to those observed when two liquids of very different densities are first mixed, such as water and alcohol.<sup>i</sup>

As the glass in the operations of blowing is taken up nearly from the same part of the pot, and as in the casting of glass the pot is suddenly reversed and its whole contents mixed together, it is found that blown glass is much more uniform than that which has been cast.

The name of threads is particularly given to those veins which are produced by the vitrification of clay. They are greener than those produced by the calcareous earth. These threads render the glass very brittle, when they are abundant, or when any of them are of considerable size, because the contraction and dilatation of this kind of glass, from change of temperature, are very different from those of the glass of sand and flint.

Tears are the greatest defect which can be found in glass.

They are the drops of glass afforded by the vitrification of the furnace of fusion. Articles in which these are found are brittle. Most of them break by the alternations of temperature, and that the more surely, the nearer the tear is to the surface. Such articles are generally thrown aside in the glass-house.

Cords are asperities on the surface of certain articles of blown glass. They are produced whenever the heat of the furnace becomes so low, that the threads of glass which fall from the pipe into the crucible cannot resume the proper degree of fluidity. When this appearance presents itself, the work is given up, till the heat of the furnace is again brought to the requisite degree.

The small bubbles abundantly diffused through certain glasses, show that the refining is imperfect. They arise from the disengagement of elastic fluid during the vitrification. This imperfection shows, either that the quantity of flux has been too small, or the fire too weak. In the first case, the glass may be used to hold liquids, without fear of being attacked; in the second, the glass is tender and easily acted on by acids, if the flux were of an alkaline nature, because its proportion is too great.

Bubbles may also be produced in glass, during the working, by certain foreign matters, which are fixed, and emit aerial fluids by the heat.

Knots are of three kinds. They are either formed by grains of sand enveloped in the glass, or by the salt of glass which is found in pieces, or white flocks, or lastly by pieces detached from the crucible or the sides of the furnace.

The fused glass has the property of sticking to an iron rod or tube, by which means it is taken out, either to ascertain its state of perfection, or to blow it into such utensils as may be wanted.

The quantity to be used at once is regulated by a process somewhat resembling that of tallow-chandlers; that is to say, the part first dipped out is suffered to cool a little, and serves as a receptacle for more glass to be taken up at a second dip, and so forth, until the quantity is sufficient. The lump of glass may be softened at pleasure, by holding it before the mouth of the furnace. The workman renders it hollow, and of a spherical form, by

blowing through the tube. This sphere may be converted into a cone, a cylinder, or any other solid, the transverse section of which is a circle, by rolling it on a flat plate of iron. It may be stretched in length by swinging the tube in the air, or giving it a vibratory motion like that of a pendulum. The workmen show great dexterity in heating the glass in the various stages of the manipulation. They do this in such parts as they are desirous of extending; and on other occasions they cool certain parts of their work, by fanning the air against them. The glass, in the ignited state it possesses after it comes out of the pots, is very tough and flexible, may be cut with shears, bended with pincers, pressed into moulds, and wrought in a variety of methods dependent on these properties, of which the artists very dexterously avail themselves.

As far as observation has hitherto directed us, it appears to be a general rule, that the hardness, brittleness, elasticity, and other mechanical properties of congealed bodies, are greatly affected by the degree of rapidity with which they assume the solid state. This, which no doubt is referible to the property of crystallization, and its various modes, is remarkably seen in steel and other metals, and seems to obtain in glass. When a drop of glass is suffered to fall into water, it is found to possess the remarkable property of flying into minute pieces, the instant a small part of the tail is broken off. This, which is commonly distinguished by the name of Prince Rupert's drop, is similar to the philosophical phial, which is a small vessel of thick glass suddenly cooled by exposure to the air. Such a vessel possesses the property of flying in pieces, when the smallest piece of flint or angular pebble is let fall into it, though a leaden bullet may be dropped into it from some height without injury. Many explanations have been offered, to account for these and other similar appearances, by referring to a supposed mechanism or arrangement of the particles, or sudden confinement of the matter of heat. The immediate cause, however, appears to be derived from the fact, that the dimension of bodies suddenly cooled remain larger, than if the refrigeration had been more gradual.

Thus the specific gravity of steel hardened by sudden cooling in water is less, and its dimensions consequently greater than that of the same steel gradually cooled. It is more than probable, that an effect of the same nature obtains in glass; so that the dimensions of the external and suddenly cooled surface remain larger than are suited to the accurate envelopment of the interior part, which is less slowly cooled. In most of the metals, the degree of flexibility they possess, must be sufficient to remedy this inaccuracy as it takes place; but in glass, which, though very elastic and flexible, is likewise excessively brittle, the adaptation of the parts, urged different ways by their disposition to retain their respective dimensions, and likewise to remain in contact by virtue of the cohesive attraction, can be maintained only by an elastic yielding of the whole, as far as may be, which will therefore remain in a state of tension. It is not therefore to be wondered at, that a solution of continuity of any part of the surface should destroy this equilibrium of elasticity; and that the sudden action of all the parts at once, of so brittle a material, should destroy the continuity of the whole, instead of producing an equilibrium of any other kind.

Though the facts relating to this disposition of glass too suddenly cooled are numerous and interesting to the philosopher, yet they constitute a serious evil with respect to the uses of this excellent material. The remedy of the glass-maker consists in annealing the several articles, which is done by placing them in a furnace above the furnace of fusion. The glasses are first put into the hottest part of this furnace, and gradually removed to the cooler parts at regular intervals of time. By this means the glass cools very slowly throughout, and is in a great measure free from the defects of glass which has been too hastily cooled.

#### OF THE DIFFERENT KINDS OF GLASS.\*

*Flint Glass.*—The precise proportions of ingredients, are not usually known, but the following is said to make an article of the

\* From Aikin's Chemical Dictionary.

best quality, namely: 120 parts of fine clean white sand, 40 of pearl ash well purified, 35 of litharge, or else minium, 13 of nitre, and a small quantity of black oxide of manganese.

The following composition for a fine crystal glass, is given by Loysel: 100 lbs. of white sand, 80 to 85 of red oxide of lead, 35 to 40 of pearl ash, 2 to 3 of nitre, and one ounce of manganese. The specific gravity of this glass, and of the common London flint glass is about 3. 2.

*Crown glass* is the name given to the best sort of window glass; the composition of which varies considerably, but it differs essentially from the last, in containing no lead, nor any metallic oxide, except manganese, and sometimes zaffre oxide of cobalt, in minute doses, for the sole purpose of correcting the natural colour, and not as a flux. The composition is sand, alkali, either potash or soda, the vegetable ashes that contain the alkali, and generally a small portion of lime. A small dose of arsenic is often added to facilitate the fusion. The refuse pieces of glass are collected during the working, and these are added again to the next fusion, but too great a portion of them will sensibly alter the quality of the glass. These fragments are reduced to gross powder, by being heated red-hot, and immediately plunged into cold water, which splits them in every direction, and enables them to be readily broken down. A very fine glass of this kind, may be made by 200 parts of pretty good soda, 300 fine sand, 33 of lime; and from 250 to 300 of ground fragments of glass.

*Common green-bottle glass*, is made of sand, lime, and sometimes clay, alkaline ashes of any kind; barilla, sea weed (*vraic*) and slags from the iron furnaces. The following composition is given by Loysel, as a good and cheap material for bottle glass:—100 parts common sand, 30 of *vraic*, (a coarse kind of pulp made on the western coast of France), 160 of the lixiviated earth of ashes, 30 of fresh wood ashes, or any other kind of ash, 80 of brick clay, and 100 of broken glass. This composition gives no glass gall, or scum.

## NOTES.

The small fissures formed by the unequal shrinkage of the clay, are closed up by beating gently with a mallet. They are afterwards heated extremely gradually, in a small oven made for this purpose, and are slowly brought to a red heat, and kept there for the requisite time, after which they are removed, whilst still hot, to the furnace, and soldered down to their place by fire clay. A still further shrinkage takes place, when in the furnace, for which reason they are let to stand empty for a day or two before they are fitted to receive the materials for glass. These pots last, on an average, about one year, and hence they must be changed once or twice during the continuance of the furnace itself.

*Aikin's Dictionary.*

The kiln is supported on arches, beneath which is a large space for a brisk and copious draught of cold air from without. The floor of the kiln, nearly level with the ground, is covered with a grate of very strong iron bars, on which the fuel is thrown, and the flame draws very strong and fierce round the pots, and passes out together with the smoke in one body, through the top of the dome, which is lengthened into a chimney for the space of a few feet. The precise construction of a glass house, can only be understood by figures, which cannot be given in this place. At the top of the dome, between the pots and the chimney, is a kind of broad covered shelf, which is heated by the flame in its passage round it, but to a much less degree of intensity than the pots, and serves as a receptacle for the glass as soon as wrought, in which it may cool slowly and gradually. This is the *annealing oven.* *ib.*

Glass, containing much lead, has, however, the great defect of being extremely soft, so as to be readily scratched. It is also very fusible, so that thin tubes of it will bend with ease in the flame of a candle. The density of such glass is also unequal, owing to the litharge sinking to the bottom of the pots: hence the wavy appearance of some glass.

<sup>d</sup> For the finest flint glass, the best pearl-ashes purified by solution and evaporation to dryness are employed. The impurity of the alkālies does not prevent their dissolving the silex into a very good and perfect glass, for the impurities consist partly of lime, and partly of neutral salts, all of which assist in the vitrification. Glass made from these alkalies, has always more or less of a green tinge, as in the common bottle-glass, owing to the presence of iron contained in the ashes.

<sup>e</sup> Messrs. Aikins say, that 6 or 7 parts of quicklime is the proportion to 100 parts of silex, with the suitable quantity of alkali.

<sup>f</sup> Borax is the most powerful flux known. But on account of its high price, is only used in the finest kinds of plate glass, and those articles that require to be particularly clear, or to be cast in a mould.

The black oxide of manganese was early used in the manufacture of glass. It gives a purple violet colour more or less deep. But if to this purple glass, while still in fusion in the crucible, be added some charcoal, tartar, or any carbonaceous matter, or white arsenic, an effervescence takes place, the colour gradually becomes fainter, and at last entirely disappears, leaving the glass quite clear and transparent.

<sup>g</sup> When the materials are sufficiently fritted, (that is, calcined after mixture) they are thrown into glass pots, with clean iron shovels, through the side opening. The fire is previously raised to its greatest intensity, to prevent the whole furnace from being chilled, and to save time.

<sup>h</sup> Common articles are generally annealed in the course of a day. The hard glasses, and those in particular made only with alkali and earths, require much more annealing than the softer and more fusible glasses into which litharge largely enters.

<sup>i</sup> These striæ, or undulating waves in the glass, are perfectly transparent and vitrified, but produce strange distortion, when used for windows, or for optical purposes.

## ON THE MANUFACTURE OF COMMON SALT.

(MURIATE OF SODA.)

A general View of the different modes of preparing British Salt, was given by Dr. Henry,\* as connected with the discussion of the question on the fitness of of such Salt to preserve flesh and fish; but as the subject is very interesting to a large portion of our frontier citizens, the following more particular account of the processes is given, as pursued in England† and France.‡

“IN Cheshire the Brine is first pumped up from very deep wells, by powerful machinery, and is discharged into a large pond or reservoir. If the brine is weak in salt, it is generally strengthened and nearly saturated by throwing in a quantity of the more impure rock salt dug up in the neighbourhood, particularly in those salt-works that have the convenience of water-carriage from the pits. There is a considerable difference in the purity of the brine from different pits, all contain a small portion of earthy salt, chiefly sulphat of lime, and a small quantity of carbonat of lime held in solution by an excess of carbonic acid, and frequently also a little carbonat of iron. The purest brine is perfectly limpid, of a pure saline taste, and a peculiar cold green hue. This last indicates the absence of iron, for when even the smallest admixture of oxide of iron is present, the water has a yellowish cast, and the salt made from it never acquires that delicate blue-whiteness, which is considered as a criterion of its perfection. The salt-pans where the brine is boiled down are oblong shallow troughs of wrought iron, usually from 20 to 30 feet long and broad, and about 9 to 12 inches deep. They are set strongly upon masonry, over a large furnace, the flues of which draw all round the pan. The fuel is coal, of which there are many pits at no great distance. Each pan stands in a small covered building, with a pyrimidal roof formed of boards sloping downwards, but with a considerable interval between each, so as to keep off the rain, and at the same time to allow of a free passage for the steam of the boiling brine. The whole process of boiling, purifying, and evaporating the brine, is performed in this single pan.

\* Archives vol. 2. p. 179. † From Aikin's Chem. Dict. Vol. 2. p. 118.

‡ Journal des Mines.

“The brine, after standing some days in the reservoir, is pumped into the pan. When heated to about  $100^{\circ}$  it begins to grow turbid, owing to the deposition of the carbonat of lime and of iron (if any) by the expulsion of the carbonic acid which held them in solution. This forms a scum on the surface of the brine which is partly removed by a skimming dish, but much of it falls to the bottom, and if suffered to remain would materially injure the quality of the salt. To clear it out, the brine is evaporated till it begins to *salt*, that is, till a portion of the muriate of soda [common salt] begins to separate, and this falling to the bottom mixes with the carbonat of lime and gives it a body, which enables the workman to draw it out. This is carefully done, and the sediment thus obtained (called *clearings*) is thrown away, which from a pan of 24 feet by 27, usually amounts to about three or four bushels.\* The evaporation is then continued at a boiling heat, and the salt gradually collects at the surface and falls to the bottom, in beautiful crystals of a pure and delicate white, where the brine is good. As the process advances, and the salt collects in quantity, it is fished out from the bottom of the pans by wooden vessels, and poured into large hollow wooden cones, with a hole at the bottom, and suspended round the sides of the pans. Here it drains, and the drainings drop again into the pans. When the process is completed, and the contents of the pan evaporated almost to dryness (which usually takes a single day and night) the cones full of the salt are taken to a large room made very hot by stoves, where they remain till thoroughly dry.

“The grain of the salt is determined by the rapidity of the evaporation and the degree of heat used. In the common salt-making, the water is evaporated at a full boiling heat, that is, as fast as

\* Mr. Holland states in his survey of Cheshire, that in the preparation of common salt, (not stoved) after the brine is brought to the point of saturation by a boiling heat, the fires are slackened, and the evaporation is continued for 24 hours, with the brine heated to  $160^{\circ}$  or  $170^{\circ}$  of Fahrenheit. The same practice is adopted at Moutiers, after the separation of the *schelotage* or clearings, in order to separate the greatest part of the muriate and of the sulphat of magnesia, which is left in the mother water, and which would crystallise along with the muriate of soda, if the boiling were continued.

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possible, and hence the grain is small, and the salt comparatively soft. The contents of a single pan, are usually worked off in twenty-four hours, except from Saturday to Monday, when two days are taken, and hence a larger and harder grained salt is made, which is much esteemed in the country for salting cheese.

“ It is found by experience, that some brines will not readily *salt* by mere evaporation, but that some addition is required to make them work well, and the salt fall regularly. This addition is generally calve's feet jelly,\* sometimes glue, sometimes whites of eggs, sometimes blood, and in short any animal or vegetable mucilage seems to answer the purpose. It is usual to have standing in a corner of the pan, an earthen vessel, containing eight or ten pair of calve's feet, to which hot brine is added to extract the jelly, and after the *clearings* are removed, and the brine begins to salt, the workman adds a little of the jelly at discretion. The precise use of this addition is by no means obvious, nor is it absolutely necessary, but long experience has shown it to be useful in many kinds of brine.

Another difficulty sometimes arises. In general the brine when it once has begun to *salt*, goes on to work well to the last, every part of the surface being sufficiently covered with small crystals of salt, which soon grow into a group, forming a small floating island of salt, which soon sinks to the bottom by its own weight, and leaves a clear surface above, which again is covered in the same manner. But sometimes, from some unknown cause, a thick shapeless crust of salt forms rapidly over the whole pan, which soon hardens to a dry floating cake of salt, preventing in a great measure the escape of the steam, and materially retarding the process. To remedy this, a small lump of butter, not more than about half an ounce, is thrown into the pan, which quickly melts and diffuses itself over the dry cake of salt, and causes it to break up and sink, after which the salting goes on well.

After the brine has been evaporated nearly to dryness, and indeed during the latter part of the boiling, there is deposited on

\* The jelly of the feet of oxen or cows would also answer. *Editor.*

the bottom and sides of the pan, a hard white saline and earthy crust, which strongly adheres to the pan, and is partly fused to its surface by the intensity of the fire, in proportion as the sides become dry by the loss of liquid.

This crust daily accumulates and produces much inconvenience, partly by injuring the quality of the salt, but chiefly by increasing the distance between the fire and the brine, and forming a thick coating through which the heat penetrates with difficulty. Hence it becomes necessary about once a month to discontinue the boiling for a day, and to pick and beat off this crust with hammer and chissel, often to the great injury of the pan itself. The *pickings*, or *panscratch*, as they are also called, are thrown away. Their analysis will be mentioned afterwards.<sup>a</sup>

As the greatest inconvenience in salt-making is the precipitation of the earthy impurities, and the difficulty of preventing them from mixing with the salt; a plan has lately been adopted (under patent) in some works near Northwich, of heating the brine in a separate pan to the degree at which the earthy carbonates precipitate, before it is sent into the large salting pan. It is found that the same fire, by extending the flues, will heat this preparing pan which is contiguous to the other, and the time in which one panfull is worked off is sufficient to bring the fresh portion to the requisite heat, and to purify it considerably.<sup>b</sup>

We shall now relate some of the leading circumstances of the preparation of salt in foreign countries, as far as they differ from that above described.

When a weak brine is exposed to the atmosphere, the watery part gradually evaporates, and with it the carbonic acid, which it contains, the effect of which is to concentrate the solution, and also to cause the deposition of the earth and oxide of iron, which the carbonic acid held dissolved. As evaporation much depends on the surface exposed to the air, a very ingenious method has been adopted of promoting this, by causing the weak brine to fall successively through large bundles of faggots, whereby a vast consumption of time and fuel in the subsequent evaporation is

prevented. This operation is called *graduation*, and the place in which it is performed a *graduating house*.

This consists of a very long range of rows of faggots placed perpendicularly, and rising to the height of about 25 feet and disposed in cones, the summits of which are about 6 feet in diameter, and the bases about 10. Just above the faggots is a trough perforated with holes at small intervals, furnished with stopcocks, and the whole is covered with a pent-house roof. At the bottom of the faggots is another trough to catch the brine. The length of these houses is determined by the quantity of brine wanted; sometimes it is enormous. In some parts of Germany there are graduating houses six thousand feet long, but in general they are from 200 to 1000.

The weak brine is first raised by pumps to the upper trough, when the stopcocks are turned, and the water made to fall like a shower of rain through the faggots into the trough below. It is then again forced up and undergoes the same operation successively till it is sufficiently concentrated. The state of the atmosphere has the greatest influence on the graduation of the brine. The evaporation goes on the quickest in a dry air with a moderate wind: when the wind is violent much of the brine is carried away in the state of spray or vapour, particularly when the column of faggots is not pyramidal, but has the same dimensions throughout. As a proof of this waste, Haller observes, that in the neighbourhood of these graduating houses, the ground becomes in a few years covered with the *salicornia* and other plants, which are known to require a salt soil and flourish on the sea-shore.

It has been mentioned, that in proportion as the brine becomes concentrated it parts with its carbonic acid, and deposits carbonat of lime, and hence the faggots of the graduating houses become gradually encrusted, over every twig, with a brown hard earthy matter, consisting chiefly of carbonat of lime. Thus in a course of years the faggots are entirely covered with stalactite, as in the common petrefactions, and the surfaces for evaporation become thereby so much diminished that it is necessary to replace them

with fresh faggots. The time that one set of faggots will last, is about eight or ten years.

The effect of graduation in concentrating brine is very striking. Baron Haller in his valuable memoir on the subject, gives the result of many observations on this and other particulars relating to the salt-works in Switzerland, of which he was the director.

The brine-springs in England, seldom contain more than one per cent. of salt in the natural state, but by mere graduation the brine is brought as high as 20 per cent., after which, it is ready to be boiled down as usual. To effect this concentration, therefore, 20 parts of brine must part with 19 by evaporation through the faggots. The deposition of stalactite hardly begins till the brine is brought to 5 per cent. of salt, and it ceases altogether when it is brought to 15 per cent. The graduation of the brine becomes slower as the concentration increases. With regard to the actual effect of a given quantity of faggots, Haller finds that at a mean degree of concentration, or 10 per cent., the evaporation of a single day in Switzerland, taking the average of the entire year, is 1100 cubit feet, (reckoning the weight of the cubit foot at 46 lb., of 18 oz.) in a row of faggots 20 high, and 735 long. When the sun shines strongly, the exhalation is more than double the above quantity.

A graduating house of the above dimensions is estimated to have always at work about 1,912,000 lb. of brine, and this quantity is furnished eleven times in the year to the boiling pans. There appear to be two inconveniencies in graduation, one, which is but trifling, is, that the brine extracts at first some colouring matter from the faggots, which is never totally got rid of in the subsequent evaporation, so that the salt has a little brownish tinge. The other is more serious, and it is the actual loss of brine by graduation, either when the wind is too violent, or the process managed unskilfully and the faggots not well arranged. This in some salt works is estimated as high as from 30 to 40 per cent.

A very ingenious plan has been introduced at Salines of applying the principle of evaporation by the atmosphere, not only to the concentration of the brine but to the actual crystallization of

the salt which it contains. For this purpose the brine, after common graduation on faggots, is heated in the pan till it begins to salt. It is then conveyed to another graduating house about 250 feet long, divided by party walls into six arches. These support troughs extending the whole length of the building, and furnished with proper holes for the brine to fall down. The space under each arch is filled with forty rows of endless cords stretched vertically on wooden frames, each of which contains 25 double cords parallel to each other, and about three inches asunder. The whole building contains 6000 of these double cords, about 3 or 4 lines in diameter, and about 30 feet long. The flooring of the building is made of fir planks well put together, and gently sloping to one end, to convey the brine as it falls, into a large reservoir, from which it is again pumped up to the upper trough. The side of the building most exposed to the weather is protected by a canvas. The hot brine as it passes from the boiler is sent into the upper trough, and then falls down every one of the cords in a copious stream, round which the salt gradually crystalizes in a stalactical form. When the crust of salt forms a cylinder from 2 to  $2\frac{1}{2}$  inches in diameter, it is taken off, and the process repeated. Each operation produces from 3500 to 4000 quintals of excellent salt, and requires about a month to be formed; and as this work can only be carried on in the height of summer, the cords may be charged no more than twice, or at the utmost thrice in the year.

The salt is broken by a kind of moveable flail set in a frame, in which each row of cords is placed in turn.<sup>c</sup>

The sea is an inexhaustible source of salt, and vast quantities of it are made from sea-water, in different countries. Sea-water is but a weak brine, the solid contents of which vary in different parts of the world. In the Baltic it is not more than  $\frac{1}{40}$ , in the British Channel about  $\frac{1}{30}$ , and taken at a great depth near the Equator, it is about  $\frac{1}{23}$ , in which state its specific gravity is 1.0289, according to Bergman, who has analysed it. By the experiments of this excellent chymist it appears, that an English wine pint of this sea-water (of 28.875 cubic inches) contained

	grains.
Of Muriated soda, . . . .	241
— Muriated magnesia, . . . .	65.5
— Sulphate of lime, . . . .	8.
	<hr/>
	314.5
	<hr/>

A small portion of carbonated magnesia also separates during the evaporation.

Sea-water, therefore, contains a very large proportion of other saline matters besides common salt, more so than the common brine springs, and this being chiefly muriated magnesia, the salt procured from sea-water is apt to be bitter, and subject to deliquescence unless a good deal of pains be taken in the boiling, or unless the evaporation be conducted very slowly. There are several ways of getting the salt by sea-water: in warm climates this is done altogether by the heat of the atmosphere, and this forms the large-grained strong dry salt called *bay-salt*, which is preferred to any other for curing provisions that are intended to keep for a length of time. Bay salt is made in great perfection in Spain and Portugal, by the Biscayans, and on the Mediterranean shores of France, and in the Bahama islands in the West Indies. The process is simple, and requires but little apparatus of any kind. The first requisite is a sea marsh, or shallow artificial pond, near enough to the sea to be filled at high water. A level shore must therefore be chosen, and the soil must be clayey to retain the water. The bottom of the pond is then laid out perfectly even, and beaten hard and smooth, and a channel with flood-gates is cut to the sea. The salt pools consist always of a large reservoir communicating directly with the sea at one end, and at the other with a number of smaller pits or beds on which the salt is made. The water is first evaporated by the sun's heat considerably, in the reservoir, and then conveyed to the salt-beds, which are only a few inches deep, and in which the evaporation is completed also by the sun and wind, and the salt separates first in the form of a white crust, which is broken from time to time to expose a fresh surface to the air. The concentrated brine yields

salt about twice and sometimes thrice a week in summer. The first saline crust that forms, is small grained, the latter large. Bay salt has generally a little tinge of colour, green or brown, according to the soil on which it is formed. It is only made in the summer months.

It has been supposed by some eminent observers, that when a considerable depth of brine, not saturated, remains at rest for a time, there is a gradual but invisible subsidence of the salt, so that the lower part of the column of brine will be sensibly saltier than the upper. To this has been attributed the increase of saltiness in the sea, in proportion to the depth whence the water is taken. With regard to land brine-springs, it is indeed certain, that the deepest are usually much the saltiest; but this may be readily accounted for from the constant infiltration of fresh water, which almost always lies above the salt rock, and sometimes in vast quantity. Hence it is necessary in most places, (as in Cheshire for example) to line the sides of the brine well with very strong planking, and even this cannot entirely keep out the fresh water, which always finds some way in.

But an experiment of Haller shows that there is actually a subsidence of salt, or at least something takes place which produces a similar effect. But this is too small to promise any advantage in concentrating weak brines by mere subsidence.

*NOTES by the Editor.*

<sup>a</sup> One pound of this crust analyzed by Klaproth, is composed as follows :

	<i>oz. dr. gr.</i>		
Moisture	1	6	0
Muriated lime	1	10	
———— magnesia		10	
———— soda	4	4	40
Carbonate of lime	1	2	30
Sand		3	30
Sulphate of lime	7	6	0
	16	0	0

The *mother-water*, or liquor left on the salt-pan, after all the salt that it is thought proper to work off, is taken out, is a very dense bitter fluid. Its specific gravity is as high as 1 218. Fifty cubic inches yielded by evaporation 5440 grains of dry salt, composed of muriated lime

Muriated lime	660
Muriated magnesia . . . .	840
Sulphate of lime . . . .	100
Common salt . . . .	3840
	<hr/>
	5440

δ “ In whatever manner the brine is concentrated, the free exposure of it to the air is inevitable; and from this circumstance there results a very great inconveniency, which has not as yet been attempted to be removed. This inconveniency consists in the formation of sulphate of soda, which takes place in consequence of the reciprocal decomposition of muriate of soda, and sulphate of magnesia, when the temperature is near the freezing point. This effect is certain: it is agreeably to the well-known principles of chemistry, and has been particularly observed at Moutiers. It is there known, that in cold weather the salt that is obtained is less pure than at other times, and that the mother water is then more abundant on account of the muriate of magnesia being augmented in quantity. When this decomposition is complete, which perhaps takes place in the coldest days in winter, the brine will contain for every 100 parts of muriate of soda, as far as 22 of sulphate of soda, and 6 of muriate of magnesia, instead of 15 of the one and 3 of the other, which it holds when it first comes from the spring.\*

\* By an analysis of the products of the salt pans at Moutiers, it appears that the precipitation of the sulphate of soda [Glauber's salt] diminishes considerably, immediately after the schelotage; that it afterwards augments gradually on account of the water being saturated with it, and that it is entirely separated before the evaporation is ended. The last made salt contains only sulphate of magnesia [Epsom salt]; that made towards the latter end of a boiling contains besides this 1-10th of its weight, as much of its weight of sulphate of soda. The mixt salt must contain at least as much of foreign matters. *Berthier on the Salines of Moutiers.*

The consequences of this decomposition is very prejudicial to the establishment. 1°. A part of the muriate of soda is decomposed and lost. 2°. There is obtained only a very bad salt, which effloresces in dry weather, and is deliquescent when the air is moist. 3°. A great quantity of wood must be used in the evaporation, which must be carried on slowly in order to collect the muriate of magnesia in the mother water.

There is a very simple and cheap method of performing this, which was discovered by Gren, and succeeds completely. It consists in making a cream with quick-lime, and mixing this cream with the brine. All the salts of magnesia are immediately decomposed; the magnesia is precipitated; sulphate and muriate of lime are formed, and then this last salt re-acts upon the sulphate of soda, and decomposes it in its turn, so that the brine contains only sulphate of lime and muriate of soda; the quantity of the latter is even slightly augmented. But in order that this purification should be complete, it is necessary that the brine should contain a peculiar proportion between the sulphate of soda and the muriate of magnesia, which is nearly that of 100 to 55. Unfortunately this proportion does not exist in the brine from the springs, and it would still retain, after the lime had been added, about 3-4ths of the sulphate of soda that it previously contained. This could not be separated unless muriate of magnesia could be obtained, which is however very possible; but it would be useless, as the brine, if the deliquescent salts and muriate of magnesia were got rid of, would yield a salt as fine as any in trade. Nothing, therefore, hinders the graduation by frost.\*

\* The efficacy of freezing the watery parts of the brine, which is practised in some northern countries, is very considerable; and might be readily adopted in the United States: but the cold must not be too severe, otherwise the brine itself freezes. Frozen salt water is not in hard solid masses, but is soft and crumbly. Dr. Thacher says, that "the salt made at Cape Cod, during the cool months, was exceedingly pure, while that crystallized during the heats of July and August, retained a portion of the bittern, and was not so good." See Memoirs of the Academy of Arts and Sciences of Boston, Vol. 2d. part 2. 1804.

c Another account of a rope shed is given by Mr. Berthier, in the *Journal des Mines*, in a paper on the salt springs of Moutiers, in the department of Mont Blanc, near the junction of the two rivers Doron. It was erected in the year 1788, by the Chevalier Dubutet, who invented it, and is said to evaporate the brine much quicker, and with more uniformity than the others. These rope sheds are used to concentrate the brine after having previously passed through four sheds with faggots. The economy of these graduating houses, it is stated, is very great; particularly if rope sheds are used, experience having shown that with a shed of the same size, twice as much brine can be evaporated by the latter as by the faggots.

A translation of Berthier's paper may be found in the *Repertory of Arts*, for June, July, and August, 1810.

In New-York the annual quantity of salt made, is stated in the "Brief Topographical and Statistical Manual of the state of New York," at 543,000 bushels;—of which there are made at

Onondago	.	:	.	.	.	453,840
Cayuga	.	,	.	.	.	54,000
Genesee	.	.	.	.	.	1,400
Seneca, at least	.	.	.	.	.	25,000
Ontario, about	.	.	.	.	.	8,760
Total value \$147,000						543,000

The quantity of salt made in the western states, and in Pennsylvania, cannot be known until the publication of the returns of the Marshal, by Congress.

The Onondago salt, can be taken by water to Catharine-town, at the head of the Seneca Lake, from whence there are but 18 miles to Newton, on the Tioga, in the state of New-York, by a road authorized to be turnpiked, which communicates directly with the Susquehanna and Tioga turnpike, now opened to Berwick, from whence a turnpike is completed to Lausanne, at the head of the Lehigh Navigation, communicating with the Dela-

ware by Easton : from Newton the Tioga and Susquehanna also afford an excellent navigation to Berwick. From Wilkesbarre, above Berwick, there is also a turnpike to Easton. All the settlements on the east branch of Susquehanna, from Newton, on the Tioga, to Havre de Grace, would find a convenient supply by water, with the interruption only of the portage of 18 miles from the head of Seneca lake to Newton.

Those on the west branch of the Susquehanna, and in the centre of Pennsylvania, can be supplied from Newton, by the Painted Post, by Wellsborough, and the Big Meadows, at the third fork of Pine Creek, which is a navigable stream emptying into the west branch of the Susquehanna.

The settlements to the westward of Pennsylvania, can also be supplied with salt from the head of Seneca lake, about 86 miles from the navigable waters of the Oswayo, which empties into the Alleghanny river, and by the excellent navigation of which, all the western counties could be supplied at a much less expense than by Oswego, Lake Ontario, Niagara, Lake Erie, Le Bœuf, French creek, &c.

The communications requisite to be opened, or rather to be made good roads, for the effectual and easy transportation of this essential article through all the extent of country alluded to, are, the *Great East and West road*, leading from Coshecton on the Delaware, to Le Bœuf and the western extremity of the state ; the road from the head of the Seneca lake, to Newton on the Tioga, only 18 miles—and the Susquehanna and Tioga turnpike road, which opens a direct communication between the city of Philadelphia and the Genesee country.

Salt works have been established for several years at Cape Cod, at Dennis in Barnstable county ; and recently at Sag Harbour, on Long Island, and Hog-neck, in the same neighbourhood, by simple evaporation, without fire. The process pursued at Cape Cod, is described by Dr. Thatcher, in the *Memoirs of the Boston academy of Arts and Sciences*, Vol. 2. part 2d. That adopted on Long Island, is stated in the *Medical Repository*, Hexade 3d. Vol. 2. p. 285. This last is calculated greatly to diminish labour,

and the account should be consulted by all those about to undertake the manufactory of salt.

*Editor.*

The following official document, by the Secretary of the Treasury, on the Salt trade, will throw light on this interesting subject.

### A STATEMENT,

Shewing the quantities of Salt imported into the United States, for each of the years, ending on the 31st of December 1802, 1803, 1804, 1805, 1806, and 1807 ; exhibiting also the quantities re-exported, the allowance made for salt used in the curing of fish and salted provisions, and the quantities actually paying duty for said period.—*Bushels of 56 lbs.*

YEARS.	IMPORTED.	EXPORTED.	Allowance for salt used in curing fish and provisions.	PAYING DUTY.
1802	3,948,434	34,235	669,890	3,244,309
1803	3,542,872	23,635	758,589	2,760,648
1804	3,433,996	31,047	963,708	2,439,241
1805	3,782,328	12,503	953,370	2,816,455
1806	4,262,704	84,850	993,755	3,184,099
1807	4,597,033	111,186	943,175	3,542,672

Mr. Gallatin states, that "the annual average is almost three millions of bushels, weighing each 56 lbs., equal to 75,000 tons, and requiring in fact 125,000 tons of shipping for its importation. It must also be observed, that the deductions above mentioned, being calculated by the allowances on fishery and drawbacks ; and the allowance being in fact greater than the amount of duty on salt employed in the cod-fishery, the quantity of imported salt actually consumed in the United States is greater than appears by the statement."

\* From the 1st of October, 1800, to the 30th of September, 1801, the quantity of salt imported was 3,282,863,—bushels, each estimated at 56 lbs. See *Med. Repos.* Vol. 8. p. 83.

*Editor.*

The following interesting Commercial Document, is taken from the  
London Monthly Magazine, for December last, 1811.

## MONTHLY COMMERCIAL REPORT.

### OUR AMERICAN COLONIES.

#### CANADA.

THE national importance of this Trade cannot be more prominently shown, than by stating the Exports and Imports of Canada in 1810, which are extracted from the annual printed Return sent from Quebec, and the amount of the tonnage employed in the trade of the several British Colonies in North America, during the last four years.

#### CANADA.—EXPORTS.

The value of the Exports from Quebec (ster.)	£942,324	9	3
Ditto of Furs, Skins, &c. (sterling) . . . . .	120,535	9	7
Total Exports from Quebec, in 1810 (ster.)	1,062,827	18	10
Disbursements for Provisions and Ship's Stores for 661 vessels, at Quebec, in 1810—			
Average about 350 <i>l.</i> sterling each . . . . .	231,350	3	0
Freight of these vessels averaging about 216 tons each, or about 230 load each ship, at 7 <i>l.</i> per load . . . . .	1,064,210	0	0
Total sterling : .	2,358,387	18	10

The Exports from Canada to the United States, *via* St. John's; and the Exports from the Departments of Gaspe and the Bay of Chaleurs, are not included in this statement.

#### IMPORTS.

Value of Imports into Quebec, in 1810, of			
Articles liable to Duty, about (sterling)	£372,137	0	0
Ditto of ditto, not liable to Duty, estimated at	600,000	0	0
Total Imports into Quebec in 1810 (sterling)	£972,837	0	0

## SHIPPING.

<i>Ships cleared out which entered Quebec</i>	<i>Ships.</i>	<i>Tons.</i>
in 1810. . . . .	635	138,057
Ditto, newly built there . . . . .	26	5,836
Total, average 216 tons each . . . . .	661	143,893

The progressive increase of this trade most satisfactorily appears by the following statement of the tonnage employed in it during the last five years, namely:—

	<i>Ships.</i>	<i>Tons.</i>
In 1806,	193	33,236
1807,	239	42,293
1808,	334	70,275
1809,	434	87,825
1810,	661	143,893

## ABSTRACT.

In 1810,	661	143,893
1807,	239	42,293

Increase of the ships, with their tonnage employed }  
in the trade to Quebec, in the last four years. } ..... 422      101,600

## NOVA SCOTIA.

The trade with this country does not appear to have increased so rapidly as that of Canada or New Brunswick, which is in a great measure to be attributed to the depression of its fisheries, from the admission of American fish into the British West-India Islands, but which, after the first of next July, by a late order in Council, is totally prohibited. The number of ships which cleared from the several ports in this province during the last four years was—

	<i>Ships.</i>	<i>Tons.</i>
In 1807,	277	31,459
1808,	376	48,057
1809,	435	47,852
1810,	328	42,222

## ABSTRACT.

In 1810,	328	42,222
1807,	277	31,439

Increase of the ships, with their tonnage employed in }  
the trade to Nova Scotia, in the last four years, } ..... 51      10,763

## NEW BRUNSWICK.

The increase of the trade with this province is also shown by the following extract from the annual statement sent from thence of the ships which cleared out from the several ports in it, in the years—

	<i>Ships.</i>	<i>Tons.</i>
1804,	126	17,203
1805,	119	15,910
1806,	128	20,019
1807,	156	27,430
1808,	253	39,114
1809,	310	55,158
1810,	410	87,690

## ABSTRACT.

In 1810,	410	87,690
1807,	156	27,430

Increase of the ships, with their tonnage employed in the trade to New Brunswick, in the last four years }	..... 254	60,260
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## CAPE BRETON.

The trade with this island is inconsiderable, for the number of ships which cleared from thence in 1807 was only four, together 416 tons ; and in 1810 seven ships, together 948 tons ; but the trade with Prince Edward's Island is more extensive, there having cleared from thence,

	<i>Ships.</i>	<i>Tons.</i>
In 1807,	8	1,859
1808,	41	9,464
1809,	78	15,276
1810,	82	5,917

## ABSTRACT.

In 1810,	82	5,917
1807,	8	1,859

Increase of the ships, with their tonnage employed in the trade to Prince Edward's Island, in the last four years }	.... 24	4,058
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## NEWFOUNDLAND.

The number of vessels which cleared from this Settlement, for such it must now be considered, was,

	<i>Ships.</i>	<i>Tons.</i>
In 1807,	359	41,202
1808,	372	45,310
1809,	401	48,903
1810,	495	61,543

## ABSTRACT.

In 1810,	495	61,543
1807,	359	41,200

Increase of the ships, with their tonnage employed in } the trade to Newfoundland, in the last four years. }	..... 156	20,343
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## ON COPPERAS.

(From A. & C. R. Aikin's Chemical Dictionary.)

**COPPERAS** is composed of the sulphuric acid, (oil of vitriol) and iron.\* It is commonly prepared from native *sulphurets*† of iron, or pyrites, after they have undergone spontaneous oxigenation by long exposure to air. The following is the practice actually in use in England.

The usual mode of manufacturing Copperas on the rivers Tyre and Wear, is by exposing iron pyrites, (there called brasses) which are found in the collieries, to the influence of the atmosphere. For this purpose, a situation is chosen inclining towards the river, of a natural strong clay. After the soil is taken off, gutters are cut in different directions, and wells of about five or six feet deep, and two or three in diameter, are sunk where the gutters terminate. Upon this surface the brasses are laid to the

\* Hence, from the composing substances of this Salt, it is called by the Chemists *Sulphat of Iron*. It is also known by the names, *Sal Martis*, *Green Copperas*, *Green Vitriol*.

† In the original, the word is *Sulphat*: this error is not noticed in the errata.  
*Editor.*

thickness of four or five feet. The vitriolization shows itself in a white efflorescence, which is washed off by the rain into the gutters, and conveyed by pipes from the wells to a reservoir, from which there is a pipe of communication to the boiler. This is a leaden vessel, generally about 7 feet deep, 12 to 14 feet long, and 6 or 7 wide, where the liquor is evaporated for six days, during which time a quantity of old iron is added to it, as much as it will dissolve. It is then run into a crystallizing vessel, and remains there for five weeks, at the end of which time, the mother liquor is run into a reservoir, and pumped back into the boiler; or, the crystals are then removed, and after being well drained, are packed in hogsheads for sale. A single boiling from a boiler of the above dimensions, yields from five to eight tons of copperas, according to the strength of the liquor.

In some places, the pyrites require roasting, before it can be decomposed by the action of the air.\* It is dangerous and prejudicial to make too large heaps of pyrites, or to put it up into stacks, however preserved from the weather, owing to the heat generated, and the danger of inflammation.

All the common sulphat of iron, especially that prepared in the great way, from pyrites, is a mixture of two distinct salts, the nature of which was first fully shewn by Proust, and which it is necessary to be aware of, to understand the chemical changes that take place with this salt in different circumstances. The first of these is the *green sulphat of iron*, or that salt which gives the common sulphat (or copperas) its leading characters, and of which it forms by far the largest portion when fresh made, before it has been exposed to the air.

\* At Geyer, in Saxony, pyrites being *refractory*, are exposed for some time to the air, and then soaked in water for 12 hours; then roasted as in the ordinary mode of roasting ores in a large bed of faggots, and in this state plunged into water. This is repeated six times successively, with the same pyrites, by which the water becomes strongly impregnated with vitriol, and is afterwards evaporated, and the copperas crystallized as usual. The time required for the efflorescence of the pyrites, is different, owing to the quality of the pyrites. Those found near beds of coal decompose readily. *Clenel in Commercial Mag. London, 1809.* Editor.

The green sulphat dissolves in twice its weight of water, at 55° of Fahrenheit, but in less than its own weight of boiling water. It is insoluble in alcohol. It does *not* give a black colour with galls; and with the prussiated alkalies it gives a white, and not a blue precipitate, but which speedily grows yellow by contact with air. This salt is obtained by agitating the common green sulphat with sulphuretted hydrogen gas. This salt, (as well as the common sulphat recently made) though of a pale green at first, soon becomes covered with a yellow ochre when exposed to the air. The solution in water, exposed to the air, becomes turbid, and deposits a reddish yellow oxyd of iron, which gradually increases in quantity, until nearly the whole remaining liquor is changed into a red fluid, much more astringent in its taste than before, and if evaporated contains hardly any crystallizable salt, but leaves a red deliquescent mass intensely styptic.\* This saline substance is the *red sulphat of iron*, which differs from the green sulphat in many essential particulars, being uncrystallizable, and giving an immediate black with galls in any form. The first contains 27 per cent. of oxygen, and 73 of iron; the latter 48 of oxygen, and 52 of iron.

*Note.*—As it is proved by Proust, that the *common sulphat of iron*, contains two distinct salts, possessing characters entirely different from each other, it follows, that in the preparation of ink, the result must often vary, in consequence of the deficiency of oxygen. As it is necessary, therefore, in order to produce a perfect black ink, that the iron should be oxydized to the maximum in the sulphat, it has been prepared by making in the first instance, the red sulphat.

The purification also of copperas, by crystallization, is important to the ink manufacturer; for, by this process, the extraneous matter is not only separated, but perhaps the iron itself is further oxydized. The green sulphat may be converted wholly

\* The theory is as follows:—The solution imbibes oxygen from the air, and a portion of the iron becoming too much oxidized, falls to the bottom in the form of ochre.—*Nicholson's Chemical Dictionary.*

*Editor.*

into the red sulphat by several process—for instance, as follows: nitric acid added to the green sulphat, is decomposed, and the red sulphat is formed; nitric oxyd gas being evolved.

The proportion of nitric acid (concentrated spirit of nitre) to the copperas of the shops, to convert it into the red sulphat, is one ounce to the pound. The acid is added to it in a cup, or convenient vessel, and exposed to the action of a gentle heat. The nitric acid is thus decomposed; a part of the oxygen unites with the sulphat, whilst the other portion is dissipated in union with azote, forming the nitric oxyd or nitrous gas. The red sulphat, if it be necessary, may then be dissolved in water and crystallized.

Common copperas, if exposed to a dry atmosphere, loses its water of crystallization, and becomes covered with a brownish powder, which, on examination, will prove to be iron, combined with a portion of acid, forming the sub-sulphat of iron.

If the copperas be taken in this state, and dissolved, filtered, and again crystallized, it will be found to be extremely pure; still containing, however, a mixture of the green and the red sulphat. This process is actually found essential to the making good ink, when the brown powder forms on the copperas.

J. CUTBUSH.

Pyrites differ very much in form—the following are the principal varieties:

1. Common Pyrites—colour, brass-yellow; sometimes by tarnishing, it is superficially reddish or brownish; of a cubic form. They occur in almost every kind of rock.

2. Radiated Pyrites—colour, brass-yellow, but paler than common Pyrites; surface generally tarnished. It occurs in mass, but usually in particular forms, such as kidney-shaped, tuberos, globular, &c. This is rarer than common Pyrites, and decomposes easily, upon exposure to the air.

3. Capillary Pyrites—colour, bronze-yellow, passing into steel gray; occurs in veins, with lead and silver ores.

4. Cellular Pyrites.

## 5. Liver Pyrites.

## 6. Magnetical Pyrites.\*

Black Cubic Pyrites abound in Lancaster County, Pennsylvania; and are there called *Jack stones*. During the revolutionary war, copperas was made to great profit, from them, by an old miner, who lived near a mine which had been opened for copper, but abandoned, and from which a large quantity of pyrites had been thrown up. After the peace, he communicated his process to two country lads, who continued to make it occasionally, by the following process:

"They take a quantity of the pyrites, and heap them carelessly upon a row of sticks of wood, supported by stones, in the same manner as the andirons support the wood on a hearth; they then lay another layer of wood across these pyrites, and so keep adding layer upon layer, imitating in some measure a number of cross bars lying upon each other, until they put as much of the pyrites on as they think proper; the wood is then set on fire, and requires no further attendance: the combustion sometimes goes on, by means of the sulphur, for *two or three days*, and by that time the mass is fit for the next part of the process: they put the burnt pyrites into a wooden cask, holding about thirty or forty gallons, and fill it about two-thirds full, with them; the rest is filled up with water; after standing a while, the liquor, now strongly impregnated with copperas, is drawn from the bottom of the cask, by means of a plug-hole, exactly in the same manner as the soap-boilers make their ley: this copperas-ley they boil down in a little *leaden boiler*, holding perhaps fifteen gallons, and they supply the waste by adding more of the ley; and when a small thin crust forms on the top of the hot liquor, they withdraw the fire, and suffer it to cool, and from this quantity of materials, they collect thirty pounds of as pure copperas as perhaps was ever made in any country. The whole of this process (except the burning of the pyrites) is performed in a small stone building, scarce eight feet high and ten feet square, and, except

\* Aikin's Dict. Vol. I, p. 582.

the building, the utensils were scarcely worth three pounds; the trouble was so small, and the attention required so trifling, that these two lads only dedicated that time to the making of coppe-ras, which they snatched from the toils of managing a large farm, and I have certain accounts that the whole process never required more than three or four hours of their time.

“If such a quantity can be made, under all these disadvantages, how profitable might such a manufacture be to a person who could dedicate all his time to it, and with the small expense of encreasing the size of the manufactory ten-fold, which would be very far from encreasing the difficulty in the like proportion: and if twelve cords of wood can be so applied, in a lime kiln, as to keep seven hundred bushels of lime *red hot* for three days and three nights, how cheaply might the pyrites be burnt in a well constructed kiln, seeing it is not necessary to apply the heat above a few hours, as the pyrites afford materials for their own combustion; if, to all these advantages, a situation favourable for a water carriage to a market, it appears to me very probable, that with but very little hazard and expense, a very profitable manufactory might be erected: such a situation, I think, may be found on the river Delaware, and no doubt upon many other navigable waters of the United States.”\*

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## EXPORTS OF THE UNITED STATES,

FOR 1811.†

*Treasury Department, Jan. 21st, 1811.*

SIR,

I HAVE the honour to transmit herewith a statement of goods, wares, and merchandize, exported from the United States, during one year, prior to the first day of October, 1811, and amounting to 61,316,833 dollars.

\* Pennington's Chemical Essays, p. 144. Philadelphia, 1790. *Editor.*

† National Intelligencer.

The goods, wares, and merchandize, of domestic growth or manufacture, included in this statement, are estimated at	\$45,294,043
And those of foreign growth or manufacture at	16,022,790
	<hr/>
	\$61,316,833

The articles of domestic growth or manufacture, may be arranged under the following heads, viz.

Produce of the sea,	1,413,000
----- forest,	5,286,000
----- agriculture,	35,556,000
Manufactures,	2,576,000
Uncertain,	663,000
	<hr/>
	\$45,294,000

And they were exported to the following countries, viz.

To the dominions of Russia, Prussia, Sweden and Denmark,	3,055,833
Ditto Great Britain,	20,308,211
Ditto Spain and Portugal,	18,266,466
Ditto France and Italy,	1,194,275
To all other countries, or not distinguished,	2,469,258
	<hr/>
Dollars,	45,294,043

The goods, wares, and merchandize of foreign growth or manufacture, were exported to the following countries, viz.

To the dominions of Russia, Prussia, Sweden, and Denmark,	5,340,117
Ditto Great Britain,	1,573,344
Ditto Spain and Portugal,	5,772,572
Ditto France and Italy,	1,712,537
To all other countries, or not distinguished,	1,624,220
	<hr/>
Dollars,	16,022,790

I have the honour to be, with great respect, sir, your obedient servant,

ALBERT GALLATIN.

The honourable the Speaker of the House of Representatives.

## ACCOUNT OF THE STEAM ENGINES

OF OLIVER EVANS.

*Mars Works, Feb. 22d, 1812,*

SIR,

IN answer to your several queries of yesterday, viz.

1. What are the principles and structure of your improved steam engines, and how do they differ from the well known English engine of Bolton and Watt?

2. How many are in use, where situated, for what purpose are they used, and by whom owned?

3. How many are you making, for what purpose, and by whom engaged, and where are they to be used? I reply:

My improvement consists, 1st, in the application of a principle in nature, viz. every addition of 30 degrees of heat by Fahrenheit's thermometer, to the temperature of water, doubles the elasticity or power of the steam; so that doubling the heat of the water, increases the power of the steam about 100 times.

2d. In the construction of my engines, of such forms, as to generate steam rapidly, and at the same time be capable of holding steam of high elastic power, which enables me to make my small engines as powerful as the great ones formerly used.

My engines are wrought with high elastic steam. The temperature of the water being 302 degrees; the power of the steam 120 lbs. to the inch area of the piston, will carry a load from fifty to one hundred lbs. to the inch area, as we choose to work: doubling the consumption of fuel in a given time, gives us about sixteen times the power. The higher the elasticity of the steam, the less fuel is required to obtain a given power. Any given power can be obtained with one-third the fuel, and one-fourth the weight of engine; therefore they will excel more for propelling boats and land carriages, than they have already excelled for mills. They require not more than one-fortieth of the usual quantity of water, while we do not condense to take off the resistance of the atmosphere, and when we do condense, less con-

densing water is required. Therefore they can be set any where on a common water well.

If the water proves impregnated with limestone or salt, then I make my boilers inexhaustible, so that not more than one cubic foot of fresh water will be used in 24 hours, producing a twenty horse power. This is done by using the salt or limestone water to condense the steam to water again, to supply the boiler; and none is wasted, except the small quantity that is decomposed and changed into air, by which means no sediment can accumulate to cause the boilers to burn out.

3d. My engines are simple in their structure, having but one valve rotatory in its motion, answering all the purposes of four, used in other engines; and they will last as long as the cylinder, say 100 years.

They are safer from accidents; the boilers being cylindrical, will hold steam ten times as powerful as we ever wish to use it.

See my book, explaining the principles fully, page 60, where I shew the difference of the costs and expense of keeping one on the old principles, and one on the new, at work 10 years, to be \$40,000.

Yet this great improvement is strongly opposed by many who ought to know better; and would have been with great difficulty brought into use, had not Congress enabled me to stem the torrent of opposition, by their act for my relief.

There are of my engines now at work,

1st. One of twenty horse power, began in 1803, by M'Keever and Valcourt, at New Orleans, to propel a boat; but they were burnt out by incendiaries, before they had the opportunity of trying the engine to the boat. The engine was repaired, and is applied to saw timber in Florida.

2d. One of twenty horse power, applied to saw timber, at Mansihak, in Louisiana; the weekly task has been 18,000 feet boards, besides grinding all the corn wanted for use, driving four saws and a pair mill stones. The property of William Donaldson, esq. New Orleans. (*a*)

3d. One ten horse power, first set up at Lexington, Kentucky,

by Luther Stephens, the inventor of the improved rotatory valve, now used. It was made inexhaustible, as the water was impregnated with limestone, and applied to grind grain, but now removed to Natchez, and applied to sawing timber. The property of Messrs. Foster and Withers.

4th. One for manufacturing flour, at Pittsburgh, twenty or twenty-four horse power, doing the work of 60 or 72 horses, grinding 20 bushels grain per hour. The property of Owen Evans and Son, and Oliver Evans and Son.

5th. One at Middletown, Connecticut; the property of the Middletown Woollen Manufacturing Company; twenty-four horse power, driving all the machinery for carding, spinning, reeling, weaving, washing, fulling, dyeing, shearing, dressing, and finishing. The steam, after doing all this, warms the house, heats water, &c. and serves instead of oil, in dressing the cloth. It is preferred by the artist, Mr. J. Sandford, who directs the establishment, to all he had seen in England, after remaining there thirteen years, and seeing all the best British steam engines. (*b*)

6th. One in Pittsburgh, ten horse power. The property of Mr. Eichbaum and Son; and applied to draw iron wire, grind glass, turn wood and metals, &c.; it works very well. This engine was first set up in Philadelphia, to saw timber, by a steam engineer, instructed in the old principles; but he could not make it work above one minute at a time, nor would he suffer me to correct his errors, but took it down and sold it, and set up one on old principles, which he thought he could make work better; and cautioned the public against the errors of my principles; but he has taken his last engine down also.

7th. One at Lexington, Kentucky, twenty or twenty-four horse power, set up by Mr. Luther Stephens, instead of the one he sold; it is inexhaustible also; applied to grind grain and manufacture flour. The property of the Lexington Steam Mill Company.

8th. One at Marietta, Ohio, twenty horse power; grinding grain and manufacturing flour. The property of the Marietta Mill Company: David Putnam, esq. president. (*c*)

9th. One at Vidalia, opposite Natchez, on the Mississippi, now setting up, to saw timber; twenty-four horse power. The property of Joseph Vidalls, esq.

10th. One at Mars Iron Works, Philadelphia, five or six horse power, applied to turn and bore iron, in aid of manufacturing steam engines, and other machinery. This, though last mentioned, was first made, and applied to grind plaster and saw marble, to show the principles in operation.

I have made, at my works, ready for setting up, the following engines :

One thirty horse power, will do the work of ninety horses; it is to be applied to a variety of purposes, for manufacturing, &c. &c. The property of Doctor George Hunter.

One twenty-four horse power, to be applied to saw 5,000 feet boards in 12 hours day, and grind 220 bushels grain in 12 hours night. The property of Hunter and Evans.

One twenty horse power, to be applied to propel a boat in Merimack canal and Merimack river.

One I am making for a boat to run in the Mississippi; the weight of this engine will not exceed one-third that of a common twenty horse power; and its greatest power when wanted, will perhaps exceed 40 horses. The property of Vidall and Evans. The boat loaded with the engine, 100 passengers, with fuel and provisions, will displace by sinking, a column of water about 14 inches deep by 15 wide. How fast may we expect her to run through still water?

One twenty-four horse power, to be set on a wharf, to drive three pair of six feet millstones, and grind and manufacture into flour 20 bushels of wheat per hour, in competition with many of the best water mills, situated near the same place. Of this I am to own one-fourth part.

One making at Pittsburgh, by Stackhouse & Rogers, 70 horse power, intended to roll iron, &c.

One engaged, do. twenty horse power, for a paper mill.

One do. do. twenty-four horse power, to grind grain, &c. at Cincinnati, Kentucky.

One making at Mars Works, Philadelphia, to saw 5,000 feet boards in 12 hours ; of which I am to own one-third part.

One do. for a steam boat.

Making in all, 10 in use ; and 10 made, making and engaged.

I discovered the principles of these engines, when an apprentice boy, 36 years ago, and have been labouring all my life to get them introduced into use, for propelling boats, wagons, and mills, &c. ; you may perceive, that as soon as I had the power, they began to progress rapidly. All I receive for licenses to use my other improvements, I am laying out to bring my engines into use ; and I am clearly of opinion, the time is not far distant, when the old principles will be abandoned as useless, as certainly as, that those millers who first opposed my improvements in the manufacture of flour, now adopt and use them.

I am, Sir, your most obedient servant,

OLIVER EVANS.

DR. J. MEASE.

*Notes.*

(a) With respect to the second engine mentioned, Mr. Evans published the following statement in 1808 :

Mark Stackhouse, steam engineer, one of the three workmen who went to set up one of my improved steam engines, in Louisiana, for sawing timber, has returned, and makes the following report, viz.

“ That he and the other two, with others to assist them, were engaged for the first six months in a cypress swamp, in building houses, bridges, making roads, preparing timber for the saw-mill, &c. That from the day they began to frame the saw-mill, until the day he left the works, was 12 months and 15 days ; during which time, they built the saw-mill in the most permanent manner, 51 by 40 feet, calculated for four saws in separate frames, set up the engine and three saws, and found it to possess power to drive four ; but as three sawed as fast as they could conveniently supply the timber for, and remove the lumber, they intended to set up a pair of mill-stones instead of the fourth

saw. That they had sawed 367,000 feet of boards and scantling, (chiefly boards,) French measure; which, owing to the high price of lumber in that country, had (in his opinion,) already defrayed the whole expense of his establishment, viz. of the engine, saw-mill, buildings, wages, and expenses of every kind. That nothing relating to the engine had broke, or went out of order so as to stop the mill one hour. They sawed by day only, and the three saws cut from twenty-five hundred to three thousand feet French measure, per day of 12 hours; and the engine consumed about one and an half cords wood per day."—Here ends his report.

The working cylinder of this engine, is only nine inches diameter, and the stroke of the piston three feet, making thirty-six strokes per minute, and works without a condenser; the fire is applied to the outside of the boiler, yet possesses power equal to twenty horses, and will do the work of sixty horses, if kept going day and night; this simple form will suit most situations; but where fuel is dear, the fire flue may be passed through the centre of the boiler; a larger cylinder, with a condenser to take off the resistance of the atmosphere, may be used with advantage, and by thus putting the whole of my improvements into operation, I have reason to expect, to produce effects equal to the best English engines, with one-third part of the fuel, because it appears that doubling the consumption of fuel on my new simple principle, gives the engine sixteen times the power.

(b) Mr. Sandford says, in a letter to Mr. Evans, "as to the engine we had from you, it continues to perform with increasing credit, and thus far exceeds any thing of the kind I ever saw. It is my opinion, that it will continue superior to all other modes of constructing steam engines; as to all former constructions for that purpose, they are so far inferior, in my opinion, that I would not take them as a gift, could I obtain yours at your price."

ISAAC SANDFORD.

*Middletown, (Conn.)*

*June 16, 1811.*

The following additional testimony in favour of this machine, has been received recently :

*Middletown, Feb. 27, 1812.*

MR. O. EVANS,

*Sir*—It is now nine months since we have had your improved steam engine in operation at our woollen manufactory ; during which period, we have been gradually loading it with machinery of different kinds, and having now got all that we intend for the present at work, it is with much pleasure we make known to you our high opinion respecting it. We consider it in every respect superior to Watt and Bolton's improved engines. Its simplicity is such, that any lad of common parts can take care of it, with a day's instruction. Very little sediment collect in the boilers, and an examination of them twice a year is sufficient—the piston requires packing once a month—the rotatory valve, through which the steam is admitted and discharged from the working cylinder, is an important improvement, and answers the most sanguine expectations we had formed of it. Your method of applying the steam as the prime mover of the piston in the working cylinder, both up and down, is so obviously preferable to the English method of using it only as the best means of forming a vacuum, that your engines must, before long, be universally adopted. The prejudices and erroneous opinions which have existed with some respecting them, will be dissipated—and when they get generally into use, you will have the satisfaction of knowing that you have done your country great service, by a saving of vast sums of money in this one article. Mr. Morrison, of Boston, came here last summer to see your engine, and was so highly pleased with it, that I understand he has engaged one from you for propelling boats on the principle of an endless chain. I hope it will be ready, as he expects it to be sent as soon as the Delaware is navigable.

Our engine requires about 96 feet of oak wood, or three-fourths of a cord, to work 12 hours with our present machinery. We derive great advantages in using your steam engine in preference to a water power, in our woollen manufactory—the heat

that escapes from under the boilers, and the steam that has done its work, enable us to warm our rooms in winter, so that the risque from fire is greatly lessened—and we have a temperature that is very advantageous to us in working wool in winter. Our factory is not liable to be carried away by freshets; and in using steam, we have an agent always at command, that will neither freeze up in winter, nor be affected by a drought in summer.

I remain, dear sir, respectfully yours,

ARTHUR W. MAGILL,

Superintendent for the Middletown Manufacturing Company.

(c) The following notice of the mill at Marietta, appeared in the newspapers lately :

“ On Tuesday, the 7th instant, (January,) the steam mill at Marietta, was put in operation for the first time, and its success met the most sanguine expectation of the proprietors. It was built by William Green, of Zanesville, and is universally allowed, by good judges, to be of superior workmanship. The house is capacious, well constructed, and built altogether of hewn stone. It stands on the west bank of the Muskingum, about thirty rods from its confluence with the Ohio, and is easy of access by water, at all seasons of the year. There is yet but one pair of stones in operation, which were taken from the banks of Racoon creek, in the state of Ohio, and are said to be equal if not superior to the celebrated burrs. They will grind a bushel of grain in three minutes. The proprietors, Messrs. Gilman, Barber, Skinner, Fearing, and Putnam, contemplate to attach to the mill a carding, spinning, and woollen factory.

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### OLIVER EVANS' PATENTS.

IN consequence of an expression\* in the address of Mr. Thornton, of the patent office, on the subject of application for

\* “ In applying for a patent, it is necessary to attend to every legal form, for in consequence of inattention to forms only, some of the patents, (Oliver

patents, an opinion has been expressed to the editor by some of the distant subscribers to the "Archives," that Mr. Evans had no further claim upon those who used his numerous and valuable improvements in manufacturing flour;\* but the following statement will show the incorrectness of such opinion.

The law requires that the patent shall "recite the allegations and suggestions of the petition for the patent, and describing the invention or discovery, clearly, truly, and fully." Unfortunately Mr. Evans' patent was deficient in that point, and in consequence, he was cast in the year 1807, in an action which he commenced against — Chambers, who had for a long time used his improvements without having paid for them. But Congress passed the following special act in favour of Mr. Evans, on the 21st January, 1808, thereby making up for the neglect of the public officers who drew up his patent. It is to be regretted that Mr. Thornton did not state this fact, as much litigation might have been thereby prevented.

*An act for the relief of Oliver Evans.*

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That it shall and may be lawful for the Secretary of State, on application in writing by Oliver Evans, to cause letters patent to be made out in the manner and form prescribed by the act entitled, "An act to promote the progress of useful arts, and to repeal the act heretofore made for that purpose," thereby granting to said Oliver Evans, his heirs, executors, administrators, and assigns, for a term not exceeding fourteen years, the full and exclusive right and liberty of making, constructing, using, and vending to be used, his invention, discovery, and improvements, in the art of manufacturing flour and meal, and in the several machines which he has discovered, invented, improved, and applied to that pur-

Evans's among the number,) issuing formerly, have in the course of law, been declared null and void." See Archives, Vol. I, p. 410.

\* Mr. Evans' patent was dated December 18th, 1790. It was the third patent granted by the Federal Government.

pose : provided, That no person who may have heretofore paid the said Oliver Evans for license to use his said improvements, shall be obliged to renew said license, or be subject to damages for not renewing the same : And provided also, That no person who shall have used the said improvements, or have erected the same for use, before the issuing of the said patent, shall be liable to damages therefor.

J. B. VARNUM,  
Speaker of the House of Representatives.  
GEO. CLINTON,  
Vice-President of the United States, and  
President of the Senate.

*January 21, 1808.*

APPROVED,

TH : JEFFERSON.

The following circulars have been issued by Mr. Evans, in consequence of the above act :

In pursuance of said act, letters patent were made out, and delivered to said Oliver Evans, bearing date January 22d, 1808, granting to him, his heirs, executors, administrators, and assigns, for the term of fourteen years, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, his said improvement ; and also of making, constructing, using, &c. all the machines, viz. his improved elevator, his improved conveyer, his improved hopperboy, his improved drill, and his improved kiln drier.

Under my said patent, my established prices for license to use my said improvements in the manufacture of flour and meal, are as follows, viz.

For elevating and conveying grain, elevating and conveying meal, and for cooling the meal and attending the bolting hoppers in a single mill, driving but one pair of mill-stones at a time, one hundred dollars ; and for every additional pair of mill-stones driven at the same time, either by the same wheel or power, or by different wheels or powers, one hundred dollars.

For either elevating and conveying grain, or elevating and conveying meal, or for cooling the meal, and attending the bolt-

ing hoppers, when used separately, fifty dollars for every pair of stones running at the same time ; and for any two of the aforesaid parts, used jointly without the other third part, seventy-five dollars for each pair of mill-stones running at the same time.

And for elevating rice in rice mills, fifty dollars ; for each elevator for each single mill, and for the use of either of the machines for any other purpose, fifty dollars.

And for the kiln drier, fifty dollars for each pair of mill-stones, with interest, in each case, from the date of my patent, or from the time of beginning to use the same until paid.

And for license to use my patented screw mill for breaking and grinding hard substances, such as plaster, &c. or Indian corn to be ground with the cob, twenty dollars.

That the Circuit Court of the United States for the district of Pennsylvania, judges Washington and Peters presiding, did at the last October term, decide a case, and so construed the said act of Congress, as to adjudge that all those who are using my said improvements without license, are liable to damages, until they obtain license.

I do therefore give this public notice, and earnestly request all those in the United States, who are using my said patented improvements, or any of them, without my license, to pay at the above rates, to the subscriber, or James I. Rush, Philadelphia, or to Captain John Moody, of Virginia, Evan Evans, City of Washington, Nathaniel Williams, esq. Baltimore, Joseph Evans, near New-port, Delaware State, Samuel Nicholson, esq. —, or to George Evans, Pittsburgh, or to any other agent or attorney I may appoint, and who are duly authorised to receive the same, and to grant such licenses only as are subscribed with my sign manual.

Those who refuse or neglect, will please excuse me if I in future refuse to expend all my profits in travelling to collect, and should put my demands into the hands of attorneys at law, who will of course send the marshals at the expense of those who invade my rights. I will be very thankful to those who shall save me the disagreeable necessity.

OLIVER EVANS.

Philadelphia, Dec. 30, 1809.

## LAW CASE.

The following decision on the patent right of Mr. Oliver Evans, was given at the last session of the Circuit Court of the United States, held by judges Washington and Peters.

OLIVER EVANS }  
vs. }  
JOHN WEISS. }

This was an action on the case for a violation of the plaintiff's patent right, and came on upon the following case agreed :

The plaintiff being the inventor of the improvements in the manufacture of flour, hereafter mentioned, and the patent right for the same by him heretofore obtained, having been declared by the court void in the action of the said Evans against Chambers ; and the time for which the said patent was granted having also run out, an act of Congress, entitled an act for the relief of Oliver Evans, was passed on the 21st January, 1808—in consequence of which, the said Oliver duly obtained letters patent, bearing date the 22d January, 1808 ; notice whereof was given to the defendant in February last.

On the 7th May, 1809, during the continuance of the former patent, the defendant purchased of the plaintiff a right to use the said improvement at his mills, on Wissahiccon creek, in Philadelphia county, in this district, for one wheel and pair of stones ; but prior to the passing said act of Congress, he had applied and used, and continues to apply and use the same improvements, for two wheels and two pair of stones in the same mill. The question submitted, is whether the defendant is liable for damages, for the use of said improvements, in application to this second wheel and pair of stones, since the act of the 22d January, and whether if so he is liable before notice from the plaintiff. If the opinions of the court be in favour of the plaintiff, judgment to be entered generally, and amount to be adjusted afterwards by the attornies.

Judge Washington delivered the opinion of the court.

It is contended by the plaintiff, that the defendant is liable for using the plaintiff's improvement, in application to the second wheel and pair of stones, since the 22d January, 1808, or at all events, since the time when the defendant received notice of the plaintiff's patent; because the proviso in the act passed on the 21st January, 1808, for the relief of Oliver Evans, extends only to cases of improvements erected for use, or used prior to the passage of said law, and does not protect the defendant from damages, for using after the issuing of the patent, under this law, an improvement erected prior thereto.

On the other side it is insisted that such a construction would render this an *ex post facto* law, and consequently repugnant to the constitution. To avoid which, it would be so construed, as to connect with the use of the improvement the erection of it, subsequent to the grant of the patent.

Although the court at the last term, and upon the first argument, felt strongly inclined to give it the construction contended for by the defendant; yet upon further reflection, we are satisfied that we should do a violence to the words which no rule of construction should warrant.

The words of that proviso are, "that no person who shall have used the said improvement, or have erected the same for use, before the issuing of the said patent, shall be liable to damages therefor."

That is, shall be liable for having erected, *or* for having used the improvement, at any time prior to the patent. But with respect to the use of it, after the issuing of the patent, no protection whatever is afforded against the claim for damages, under this law.

The next inquiry is—does the general law give to the plaintiff a right of recovery against a person who erected a machine prior to the issuing of a patent to the first inventor of it, and who afterwards made use of the same?

The act of the 17th April, 1800, which, as to this point is the only law in force, declares that if any person, without permis-

sion from the inventor, shall make, devise, use or sell the thing whereof the exclusive right is secured to the patentee, he shall pay three times the damage sustained by the patentee, to be ascertained by a jury. Now whatever doubts might have existed as to the meaning of the words "devise and use," in the 5th section of the act of 21st February, 1793, thus connecting the using with the devising of the improvement, there can be none under the 3d section of the act of 1800, which repeals the whole of the 5th section of the old law.

It is plain that the *using* of an improvement invented by another, and secured by patent, is of itself an offence, no matter at what time such improvement was devised or made. Whether the word "devise," which has been a good deal criticised, is synonymous with *make*, as one of the plaintiff's counsel seemed to think, or means to *invent*, a mere act of the mind, a construction which, whether it be to make, or to *contrive*, to *plan*, *form*, or *design*, it is unnecessary in this case to decide, because the charge against the defendant is the *using* of the plaintiff's improvements, unconnected with the making or devising it.

But it is objected to this construction, that it would render the law *ex post facto* in its operation, in respect to one who has erected his improvement prior to the granting of the patent to the plaintiff.

It must be admitted that cases of great hardship may occur, if after a man shall have gone to the expense of erecting a machine, for which the inventor has not then, and never may obtain a patent, he shall be prevented from using it by the grant of a subsequent patent and its relation back to the patentee's prior invention. But the law in this case cannot be termed *ex post facto*, or even retrospective in its operation, because the general law declares beforehand, that the right to the patent belongs to him who is the first inventor, even before the patent is granted; and therefore, any person who, knowing that another is the first inventor, yet doubting whether that other will ever apply for a patent, proceeds to construct a machine, of which it may afterwards appear he is not the first inventor, acts at his peril, and with a

full knowledge of the law, that by relation back to the first invention a subsequent patent may cut him out of the use of the machine thus erected.

Not only may individuals be injured by a liberal construction of the words in the law, but the public may suffer if an obstinate or negligent inventor should decline obtaining a patent, and at the same time keep others at arms length, so as to prevent them from profiting by the invention for a length of time, during which the fourteen years are not running on. But all these hardships must rest with Congress to correct. It is beyond our power to apply a remedy. No such hardships exist in this case, where the defendant erected the improvement, with a knowledge not only that the plaintiff was the first inventor, but had absolutely obtained a patent, although it was afterwards declared invalid.

The circumstances of this case render it unnecessary to give an opinion as to the right of a first inventor after patent obtained, to recover against one, who believing himself to be the first inventor, constructs a machine or improvement upon the principles of his new invention, or uses the same after such patent issued.

Upon the point of notice, we think that the act of 1808 being a private act, the defendant is liable, only from the time he received notice of the law. *Judgment for plaintiff.*

### INSTRUCTIONS.

The subscriber gives to his several agents, the following instructions for regulating the prices of his licenses to use his several patented improvements, during his patent terms:

The following rule is to be observed with respect to those who take out a license within one year from the 22d of Jan. 1811.

That in no instance the price of a license shall be more than *one half of the interest* of the sums that the agent may fairly judge that the improvement will save, during the present term; nor less than *half the sum* that it will save in wages and boarding, in one year, to the purchaser of the license: of which the

agent is to be the sole judge, according to the situation for business, under the following instructions :

*For license to use his improvements in the art of manufacturing flour and meal.*

According to the quantity of flour that the mill will make.

Mill-stones 7 feet in diameter, will manufacture 49 barrels in 24 hours.

6 feet	36	do.
5	25	do.
4	16	do.

	Saved in 1 year.	Saved in 14 years.	Price of license, with interest until paid.
1. In a mill well situated for business, driving not more than one pair of mill-stones, not less than 6 feet in diameter, manufacturing from 36 to 49 barrel in 24 hours, where the labour of two men and sometimes a boy, is saved, their wages and boarding in this case, rated at	\$800	11,200	400
2. For a mill well situated for business, driving one pair of stones, not less than 5 feet in diameter, manufacturing from 25 to 36 barrels in 24 hours, where the labour of one man and a boy, sometimes two men, is saved, rated at	600	8,400	300
3. For a mill well situated for business, driving one pair of stones, not less than 4 feet in diameter, manufacturing from 16 to 25 barrels in 24 hours, where the labour of one man and a boy is generally saved, Which makes the price of license nearly 10 dollars per barrel for each barrel that mill will manufacture in 24 hours.	450	6,300	225
4. Where the mill is not so well situated for business, or does not run so constantly, but the labour of two men is saved while the mill goes,	400	5,600	200

5. In such mill where the labour of a man } \$300 4,200 150  
and boy is saved,
6. In such mill where the labour of one man } 200 2,800 100  
is saved,

Rating the price in the three last cases, at nearly 5 dollars per barrel for each barrel that the mill will manufacture in 24 hours.

One pair of mill-stones running is deemed a mill ; and where several pair are running at the same time, each pair is deemed a mill.

Elevating and conveying grain is deemed one-third part of the improvement ; elevating and conveying meal one-third part, and attending the bolting hopper, one-third part.

Those who use one-third part, pay half of the aforesaid prices. Those who use two-third parts pay three-fourths of the said prices.

Interest on the prices, until paid, is made a part of the price itself, and will in no case be abated.

Licenses may be sold within the year, at the above rates, estimating the interest on the price from the time the improvements were first used within the patent term, or for the improvements to be put in use hereafter ; and the subscriber will thankfully receive the money, which he means to apply to put other important inventions into operation.

But after the 22d of January 1812, the price shall not be more than the full sum saved in one year, until the 22d of January 1813 ; and after the 22d of January 1813, not less than the full interest on the sum saved in one year, estimated on the time the improvements shall be used within the patent term.

But after the 22d of January 1813, if any person, in defiance of the laws and patent right, shall continue to use the improvements without license, you are to deem the sum saved each year as so much lent on interest, and demand, for each year, interest on the whole sum so accumulated, until the license be applied for ; and then, to ascertain the price, add to the sum accumulated as above, the interest of the sum saved in one year, for each year to the end of the patent term ; giving every person

liberty, on paying for time past, to quit the use of the improvements.

The agent will understand, that 800 dollars saved and put to interest annually, the principal amounts to 11,200 dollars in fourteen years, and the interest thereof to 5,040 dollars; so that the price set in the first case is not more than one-twelfth part of the interest of the sum saved in the patent term in wages and boarding alone.

In the above calculations, no estimate is made of the savings; of the increase in quantity and quality of the manufacture; and of the increased dispatch of business, which more than triples the sum saved, when the improvements are fully and properly applied.

- |  |      |
|--|------|
| 7. For his improvements in grist mills, running one pair of mill-stones, grinding for toll only, and making no flour for sale,                                 | \$50 |
| 8. For every elevator in rice mills, according to the business done, and labour saved, rated by the rules laid down, but in no case less than 50 dollars each. |      |
| 9. For an elevator in a clover mill, not less than   | 30   |
| 10. For an elevator in a plaster mill, not less than   | 20   |
| For an elevator for other uses generally,  | 50   |
| 11. For license to use a screw mill for breaking plaster, or Indian corn to be ground with the cob for food for cattle,  | 20   |
| 12. For license to use his patented stove with talc or glass doors to display the light of the fire, either with or without its other improvements,            | 0    |

With interest in each case from the time the improvements were first used within the patent term until paid.

No license to be granted other than those prepared in printed blank forms by the subscriber, under his own hand and seal.

You are in no instance to call on any person more than once to demand payment, and you are to prosecute all persons for damages, that you discover using the above improvements without license.

OLIVER EVANS.

Philadelphia, Jan. 1, 1811.

## INTELLIGENCE ON ARTS AND MANUFACTURES.

THE works of the late celebrated engineer, *John Smeaton*, consisting of reports, estimates, and treatises, embracing the several subjects of canals, navigable rivers, harbours, piers, bridges, draining, embanking, light-houses, machinery of various descriptions, including fire engines, mills, &c. &c. with other miscellaneous papers, drawn up in the course of his employment as a civil engineer; illustrated with plates, in three volumes quarto, is announced as preparing for publication in London, in December last.

### COTTON, WOOL, AND FLAX MACHINERY.

IN addition to the manufactures of cotton, wool, and flax machinery, already existing in the United States, it is agreeable to see announced, that every description of machinery for the above purposes is made by *Richardson and Duff*, at Ellicott's mills, ten miles from Baltimore. The proprietors state, that as the establishment is extensive, orders to any amount can be promptly executed.

### IRON WIRE.

THE only article required to render the United States completely independent of Europe is *wire*: the principal use of which would be for cards for cotton and wool machinery. Since the non-intercourse with Europe, the article has been so rapidly consuming, that the stock of it during the last year has been very small. This great want is now likely to be partially supplied by Mr. Eichbaum, sen. of Pittsburgh, who has erected a steam engine upon the plan of Oliver Evans, for the purpose of drawing wire of every description. Mr. Eichbaum is a German by birth, and acquired his knowledge of the art by serving a regular apprenticeship thereto in his native country. He afterwards worked at it during fourteen years in London. He is master of every

branch of the business, and although he is obliged to teach all his workmen, and of consequence, to superintend personally every part of the process, he is able to make, even now, a great quantity of wire. The docility of American genius, will soon free him from this labour, and insure a compliance with all the orders that may be transmitted to him. At present the demand is greater than the state of the establishment will enable him to supply. The legislature of Pennsylvania very wisely has loaned Mr. Eichbaum, the sum of \$3,000, to enable him to set this important manufactory on foot.

The death of an ingenious mechanic, by name *Sutcliff*, has delayed the establishment of a wire manufactory near Philadelphia; but there can be no doubt, that it will be set on foot by some others. The quantity of wire used in Philadelphia, is so great, that it has been asserted 300 persons might be employed profitably in making it. One manufacturer only, consumes to the value of \$5,000 annually. The first expense of a wire establishment has been estimated at about the same sum.

#### COVERING WIRE WITH SILK, AND COVERING THREAD WITH SILK.

Mr. Thomas Saddington, of London, in the year 1809, presented to the "Society for the encouragement of arts, manufactures, and commerce," a contrivance for the above purpose; for which he was presented with thirty guineas.

By this machine, the following disadvantages attending the use of the common one for covering wire, are obviated:—First, the necessity of having work shops from 20 to 40 yards long, consequently the rent or purchase is considerable. Secondly, the disadvantage of having the wire cut into pieces of the length of the work shop, for the purpose of covering it. Thirdly, the irregularity of the work so made, unless performed by a very steady hand. Mr. S's machine may be worked in a small room, and the wire may be covered of an entire length of several thousand yards if required, with a certainty of its being regular throughout the work. Besides these advantages, it requires only one

person to work it, whereas in the common mode, two are necessary.

Certificates were received from four workmen in London, expressing their approbation of Mr. Saddington's machine, the novelty of its principle, and the accuracy of its work.

An engraving of the machine, with ample explanations of it, are given in the 27th vol. of the transactions of the society; they are also inserted in the Repertory of Arts for 1810.

### AMERICAN BURR-STONES.

A quarry of stones was discovered about two years since, which it was believed would answer all the purposes of French burrs: the experiment was accordingly made, and some of them sent to the flour mills on Brandywine, for trial, and after having been in use for some months, Messrs. Wm. Poole and Co. have published the following certificate: "we have four pair of mill-stones, made from the Georgia burrs, in the mills we work, and have supplied four other pairs, to different millers at this and other places; and we have no doubt, that if the proper care is taken in selecting them at the quarries, and in making them up, they will be found adequate to all the wants of the country. One objection only can be made to them—that they are too soft; but if taken out of the earth, and exposed to the air as the French burrs are, we believe they will be found in no respect inferior to them: in some circumstances they are much superior to the French."

WM. POOLE & Co.

*Brandywine Mills.*

One of the quarries is on Rocky creek, about 30 miles from Augusta, and 8 miles from Savannah river: another near Old-town, in the same state.

### CHAIN FOOT-BRIDGE.

A patent chain foot-bridge, invented by Mr. John Palmer, of Shrewsbury, has been erected at the factory of Messrs. Mar-

shall, Flutton, and Co., the width 5 feet, height 30 feet, span in the clear 37 feet. The chains are of wrought iron, and 5 in number; on these are laid 19 cast iron plates, forming the pathway. The balustrades are wrought iron, 3 feet 3 inches high. The materials having been prepared and brought to the spot, the bridge was erected by two men in 14 days. The total expense was £80 8s, sterling.—*Monthly Mag. London, Jan. 1812.*

#### METHOD OF SECURING THE ENDS OF THE BEAMS OF SHIPS WITHOUT WOODEN KNEES.

Mr. Thomas Roberts of the navy office, London, is the inventor of this great improvement, which has been found to succeed, and has accordingly been already adopted in sixteen frigates, thirteen 74's, and in the Caledonia, of 120 guns. Upon the recommendation of the commissioners of the navy, the king's council presented Mr. Roberts with £800, as a reward to his ingenuity, by an order of the 28th October, 1807. It appears that the "general failure of the supply required of wooden knees," led to this substitute, a full account of which may be seen in the transactions of the Society of Arts for 1807, and in the Repertory of Arts, Vol. 16, 2d series.

Another plan is proposed by Mr. George Williams, master carver at his majesty's dock yard, Chatham, an account of which is given in the transactions of the Society of Arts, Vol. 27, for 1809. He calculates that the saving in a 74 gun ship, or in an East India-man, by the adoption of his plan, will be £546 17 6 sterling. The silver medal was presented to Mr. Williams by the society, for his communication.

#### METHOD OF GILDING ON STEEL BY IMMERSION IN A LIQUID.\*

By Mr. Stoddart, a celebrated Cutler, in London.

Mr. Stoddart mentions, that the discovery of this method of gilding, belongs more to Mr. Hume, chemist, Long acre, than

\* From Nicholson's Philosophical Journal, Vol. XI.

to himself, by whose assistance he had few difficulties to overcome.

The method is as follows :—To a saturated solution of gold in nitro-muriatic acid, add above three times the quantity of pure sulphuric ether ; agitate them for some time.

The gold will soon be taken up by the ether, in form of a nitro-muriate of gold, leaving the remaining acid colourless at the bottom of the vessel, which must now be drawn off, by means of a stop cock, or other similar contrivance. The acid being discharged, the instrument to be gilt, after being previously well polished, and wiped very clean, is to be dipped for an instant into the ethereal solution, and on withdrawing it as instantly washed by agitation in clean water. This is essential, to get clear of a small portion of acid, necessarily taken up by the metal ; and if this be neatly done, the surface of the steel will be completely and very beautifully covered with gold. Some little dexterity is necessary to perform the whole operation well.

Mr. Stoddart tried some of the essential oils for the same purpose, knowing that they also will take gold from nitro-muriatic acid, but they would not answer the purpose of gilding as far as his experiments went ; he owns that he did not prosecute his inquiry with much industry, as he had found all that he wanted in the effect of ether.

#### BEAUTIFUL BLACK VARNISH USED BY COACH-MAKERS.

Take of amber 16 ounces, melt it in a clean iron pot, then add to it half a pint of drying linseed oil boiling hot, three ounces of rosin, and the same quantity of asphaltum, each in fine powder ; stir the materials together till they are thoroughly melted, and incorporated together ; then remove the varnish from the fire, and add to it a pint of warm oil of turpentine.\*

\* Aikin's Dictionary, Art. Varnish.

## VARNISH FOR SILK OR LINEN.

Take of very drying linseed oil half a pint, and of birdlime one pound, put the mixture in an iron pot, and heat it nearly to boiling, till the birdlime ceases to crackle ; then pour in two and a half pints more of drying oil, and boil it for about an hour with constant stirring, taking care that it does not boil over. When it has acquired so much tenacity that a little rubbed between two knife blades, will draw out in threads on the separation of the blades from each other, it may be removed from the fire, and well mixed with a quart of oil of turpentine, and then strained and bottled. In order to apply it, the silk or linen must be quite dry, and the varnish lukewarm ; a thin coat is to be first laid on one side, and about twelve hours after, two other coats should be laid on, one on each side ; and in 24 hours after, the stuff will be dry enough to be used.\*—*Aikin's Chemical Dict.*

## TO SALT VEGETABLES INTENDED FOR DISTILLATION.

By M. Descroizilles, sen.

(*From the Annales de Chimie.*)

Take a chiliogramme and a half (3 lbs.) of roses, rub them for two or three minutes with half a chiliogramme (1 lb.) of common salt. The flowers being bruised by the friction of the grains of the salt, yield their juice, so that there is immediately formed a kind of paste ; which is to be put by in an earthen jar, or in a barrel, until it is filled, by repeating the same process, by which means all the roses will be equally salted in a proper manner. The vessel is then to be shut up, and kept in a cool place, until it is wanted. When it is desired, at any leisure time, to distil, this aromatic paste is to be put into the body of the still along with twice its weight of water. By this means there is no occasion to be hurried by the season. According to some observers,

\* This receipt has been tried with success by a friend of the Editor.

the distilled waters obtained in this manner are much more agreeable than common, and nevertheless yield more essential oil.

*Observation.*—Some distilled waters will not keep for more than a few months ; for instance, that of orange flowers, as the Editor can assert from his own knowledge : the method of salting flowers, therefore, offers an excellent mode of obtaining a supply of fresh distilled water at any time. Roses have for a long time been preserved, by sprinkling layer after layer with fine salt ; but care must be taken, first to dry them well in the shade.

*Editor.*

### TO MAKE SOFT SOAP.

Take five bushels of ashes, damp them thoroughly on the ground, and let them stand from five hours to two days, as may be convenient ; then make up the heap in an oblong form, open the middle, and put in three pecks of perfectly fresh lime, and sprinkle about three or four quarts of water over it, and cover up : observe to use hot water in very cold weather. In large experiments, cold water will answer in any weather.

In half an hour, the lime will heat, and burst open the heap of ashes, when the whole must be well and quickly mixed, and put into the ley tub, to the depth of one foot, and beaten moderately ; another layer of ashes, of the same depth as the first, is then to be added and beaten as before, and so on until the tub is filled within six inches of the top ; water is then to be poured in steadily until the ashes are nearly or entirely spent. The ley must be of a strength scarcely sufficient to float a newly laid egg : four gallons of this ley are to be put into a large kettle, and thirty or forty pounds of fat added, and well stirred, over a gentle heat. When it is perceived, that the sharp taste of the mixture is lost, more ley is to be added occasionally, until the soap becomes transparent and very thick, and toward the last of the operation the liquid must be made to boil briskly. When the soap is made, let it stand for a day ; when, if it does not grow thin, in that time, no apprehensions need be excited as to the occurrence of

that circumstance. The kettle should be covered, and should hold more liquid than it is intended to boil, to give room for a brisk ebullition towards the close.

For **HARD SOAP**, mild ley is to be used. When the soft soap is finished, and the mixture still tolerably hot, add sea salt until the ley drops clear from the soap: if it closes, add more salt, and at the same time, slacken the fire; then boil until the froth becomes as light as a feather. Draw the fire, and pour in salt and water into the mixture to cool it, observing to make a rapid stream, and not to let any drops fall in turning up the bucket. When the soap is too strong of the alkali, it will not grain; in that case, add clean fat by degrees, until it granulates, stirring it all the time over a gentle heat. When it boils, no more fat need be added.

It is to be observed, that if the ashes have been too tightly pressed in the ley tub, the ley will not filtrate; and if they have not been sufficiently pressed, the water will run foul. In the first case, the ashes may be loosened with a long iron scower; in the latter, they must remain some hours to settle, and also be pressed.

*Observation.*—The foregoing receipts were some years since given to the Editor, by one of the best manufacturers of soap in Philadelphia, and he had it tried under his direction, with success. He has even recently recovered a large quantity of half made soap, by knowing the proportions of the several ingredients employed, and by supplying the deficient ones agreeably to the receipt; after the female farm servant declared that the mass was worth nothing. Rather less fresh lime was used than is directed.

### ON THE WARREN RABBIT.

Mr. William Bond, of Canada, in the 25th Vol. of the transactions of the Society of Arts, London, has published a paper warmly recommending the breeding of warren rabbits in Cana-

da: his paper contains remarks worthy of attention by the citizens of the United States. He says:

"In my travels through America, I have been surprised that no attempt has been made to introduce, for the purpose of propagation, that useful little animal, the *warren rabbit*, of such vast importance to the hat manufactory of England. It is chiefly owing to the fur of this animal, that the English hats are so much esteemed abroad. It is a fact well known among hatters, that a hat composed of one half of coney wool, one-sixth old coat beaver, one-sixth pelt beaver, and one-sixth vigonia wool, will wear far preferable to one made of all beaver, as it will keep its shape better, feel more firm, and wear bright and black much longer.

"When I speak of the warren rabbit, I have to observe, that there are in England, as well as in most parts of Europe, three other kinds, viz. the tame rabbit, of various colours, the fur of which is of so little value, except the white; the shock rabbit, which has long shaggy fur of little value; the bush-rabbit, like those of America, which commonly sits as a hare, and the fur of each is of a rather inferior quality.

"There are two sorts of warren rabbits in respect to colour; the common gray and the silver gray, but there is little or no difference in respect to the strength and felting qualities of the fur. The nature of this animal is to burrow deep in sandy ground, and there live in families, nor will they suffer one from a neighbouring family to come amongst them without a severe contest, in which the intruders are generally glad to retire with the loss of their coats, unless when pursued by the enemy, when they find protection.

Rabbits, particularly those of the warren, are the most prolific of the four-footed animals in the world, nor do I apprehend any difficulty would attend the transporting this little quadruped with safety to any distance, provided it was kept dry, and regularly supplied with clean, sweet food, and a due regard paid to the cleanliness of the boxes or places of confinement.

"Some idea of the astonishing increase of the rabbit, may be

had from the following facts. An old doe rabbit will bring forth young nine times in one year, and from four to ten each time ; but to allow for casualties, state the number at five each litter.

In nine months, . . . . .	45
The females of the first litter will bring forth five times the proportion, of which is $2\frac{1}{2}$ female's produce . . . . .	62
Those of the second litter 4 times produce . . . . .	50
Those of the third litter 3 ditto . . . . .	37
Those of the second litter 2 ditto . . . . .	25

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Total in one year from one pair, . . . . . 219

"The third female race of the old dam, and the second of the first litter, seldom breed the first year, but are early breeders in the spring following, when we might expect an increase of the whole proportion to the first pair, if properly attended to, and protected.

"Hares are not more than one-fourth as prolific as rabbits ; the fur is nearly as valuable as that of the rabbit."

The foregoing observations demand the serious attention of the citizens of the United States. There are many thousand acres of sandy and gravelly land, worth nothing to the owners, which might be rendered profitable, by being converted into rabbit warrens. The ground must of course be inclosed by a board fence.

I believe that the only attempt at a warren in the United States, was made a few years since by Miles Smith, esq. of New Brunswick, (N. J.) who began in the year 1800, with two couple and a half, which were all that remained of eight couple that he imported.\* His warren consists of 45 acres, and is inclosed by a fence, five feet high ; the lower half of which is of boards, and the top of railing. The following facts respecting the economy and habits of this animal, are furnished by Mr. M. Smith, jun.

\* Twelve couple of warren rabbits were shipped at Hull ; four couple died on the passage, and of the rest a dog killed all except two and a half couple, after they arrived.

"A few days before littering, the doe burrows a hole in the earth, which she enlarges at the bottom, and then pulls off a quantity of fur from the under part of her body, with which she makes a bed for her young. During a few days after littering, she seldom or never leaves her hole, except to feed, and returns in a short time. The young rabbits are suckled six weeks, and during the greater part of that time, the hole and young are carefully concealed from the buck: and when the doe goes out, the mouth of the hole is closed with mud, made of earth mixed with her urine, in order to deceive the male, who will kill them while young, if he can get access to them.

"The climate of the United States appears very favourable to the warren rabbit; the islands on the coast,\* would suit admirably for them, being sandy, and no fences requisite. They are, however, exposed to several enemies, against which it will be necessary to guard, as hawks by day, and owls by night; but their greatest enemy, is a fly that deposits its egg behind the ear of the animal, and being hatched by the warmth of the part, it works its way into the neck; and soon acquires the size of a common maggot or grub. Its existence may be known by a dizziness in the rabbit, causing it to leap suddenly, and frequently to turn round. Unless early attended to, the death of the rabbit commonly ensues in three days; but should it survive, the worm remains between the skin and flesh, grows to a large size, and leaves its abode in the autumn. The skin of the rabbit also becomes covered with small prickles, which add much to the pain excited by the worm. The remedy is to catch the rabbit, and take out the worm; after which, the wound heals readily.

"In wet weather, rabbits are subject to purging, which generally kills them.†

"The method of catching the rabbits is as follows:—A stack

\* On the sea-coast it is probable that the fly would not attack the rabbits.

*Editor.*

† To prevent this, lumps of chalk and of salt, should be placed in the warren, to give the rabbits an opportunity of licking them.

of hay is placed near the centre of the warren, surrounded by a close fence. The access to this hay, by the rabbits, (except when they burrow under the fence,) is only through a trough; the mouth of which is flush with the fence. The rabbits being accustomed to pass to the hay through this trough, as freely enter it when the pit-fall or type is set; this is constructed in the following manner:

“Inside of the fence surrounding the hay, a circular pit, four feet high, and five feet in diameter is dug, and lined with bricks; over the top is thrown the trough before mentioned; which is six or eight inches square, without a bottom, and having both ends open. The rest of the pit’s surface is covered with boards, having a door for the admission of a person. In this trough are placed two “typples,” on an axle screwed on the middle of each, which is admitted into a staple driven into the sides of the trough; one half of the under sides of these typples, which are 14 or 16 inches long, are planed obliquely from the middle, in order that one end may preponderate, so as that when a rabbit attempts to pass through to the hay, the typple is tilted by the weight, and the animal falls into the pit below; the typple is then restored by the heavy end, and in this manner is set for the next. When not wanted, a board is placed over the typples, to permit a free passage through. One hundred and thirty rabbits have been caught in one night.

“The fecundity of the rabbit is well known; but this species does not breed as often in the United States as in Europe, at least not in the soil to which they are confined at New Brunswick. The climate is certainly favourable to them. They bring forth four and sometimes six at a litter; and breed twice or thrice in a season: the first litter will commonly breed in the course of the summer. In England, the old ones breed every month.

“The skin of the warren rabbit sells for forty cents at New York, and is in great demand: the flesh is delicious, and of a delicate wild flavour.

"A number of hares were imported at the same time with the rabbits, but they all died, owing in all probability to confinement."

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PROFIT OF

DOMESTIC WOOLLEN MANUFACTURES.

Mr. S. D. Ingham, of Solebury Township, Bucks County, lately had  $19\frac{3}{4}$  pounds of wool, from half bred Merinoes, made into cloth; the account of which is as follows:

24 yards, $\frac{3}{4}$ wide; the entire expense of manufacturing	
was 77 cents per yard, . . . . .	\$18 48
Sold at $2\frac{2}{3}$ dollars per yard—or, . . . . .	60
Left for wool, . . . . .	41 52
Or per lb. . . . .	2 15
<hr/>	
The wool charged by Mr. Ingham at one dollar per lb.	19 75
Manufacturing cost, . . . . .	18 48
<hr/>	
	38 23
<hr/>	
Made per yard, . . . . .	1 59

The cloth, compared with English manufacture, was found fully equal in quality to  $\frac{6}{4}$  broad cloth, at 6 dollars a yard.

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From the Essex Register. Jan. 1812.

There is now in this office, a piece of broad cloth made in the vicinity of this town, which in texture and colour, is, perhaps, superior to English broad cloth now selling in the American market for four dollars per yard. The cloth was woven half width, or three-quarters, and all the expenses attending its manufacture, exclusive of the mere spinning, was seventy-five cents per yard. The mere spinning is worth about twenty cents per yard; consequently, this American manufactured broad cloth

actually cost no more than 95 cents for a yard of three-quarters wide, or \$1 90 for a yard of six-quarters wide.

This is 2 dollars and 10 cents less a yard, than English broad-cloth *now sells* for, of the same quality.

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The "Baltimore Weekly Register"\* gives the following statement of the cost and charges of wool, when made into blankets, at Elkton, Maryland, last autumn :

Dr. 130 lbs. wool at 50 cents,	. . . . .	\$65
Manufacture, freight, and portage,	. . . . .	64
		<hr/>
		129 00
		<hr/>
Cr. 14 pair blankets, 8 qrs. by 10, at \$9 21,	. . . . .	129 00

These blankets, in every respect, are equal, if not superior, to the English blankets ; which, before the rise of the article, sold in our stores, at from 10 to 12 dollars.

On this subject, see also "Archives," Vol. 2d, p. 200.

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#### PROTECTION OF THE RIGHT OF INVENTORS.

The cause of Messrs. Livingston and Fulton, against a company in Albany, for an invasion of their right, derived from the state of New York, to navigate exclusively the river Hudson by steam boats, has recently been decided in the court of Errors and Appeals at Albany, in favour of the above named gentlemen.

The Editor hopes to obtain a report of the important cause ; in the decision of which, every friend to the protection of genius—every friend to the prosperity of the arts, cannot fail to rejoice.

\* Vol. 2d, No. 27, p. 8. Published March 7, 1812.

ON A VARIETY OF THE  
**BRASSICA NAPUS, OR RAPE:**

By James Dickson, Vice Pres. Horticultural Soc. London. Vol. 1, part 1.

"I am unable to trace its first coming into such common use in France, but as it is distinguished by G. Bauhin, who published his *Pinax* in 1671, it must have been well known at that period. The only synonyms I dare put down as certainly belonging to it are, *brassica napus*  $\beta$  Linn. *Species Plant.* ed. 2. p. 931, *napus sativa* C. Bauhin, *Pin.* p. 95, *le navet* French, *Teltow Rüben*, German, *French Turnep*, *Anglis*.\*

"For above twelve years, I have seen this plant brought to our own market in Covent Garden, but only by one person, and I believe it has been chiefly sold to foreigners, though when once known it will be a very acceptable root in most families. It is much more delicate than our common turnip, and is to be used in the same way. In Germany, it enriches all their soups, and there is no necessity to cut away the outer skin, or rind, which is thinner than that of the common turnip, but only to scrape it. Stewed in gravy, it forms a most excellent dish, and being white, and of the shape of a carrot, when mixed alternately with those roots upon a dish, is very ornamental. The following different receipts for dressing them, are, by an eminent French cook. Wash and clean the roots with a brush, scrape them, cutting a thin slice away from the top, and as much from the bottom, as will make them all of equal lengths. Boil them in water, with a little salt, till

\* Upon examining the authorities referred to by Mr. Dickson, the Editor is of opinion that he has mistaken the name of the plant: it does not resemble the rape (*Brassica napus*) in any respect; it rather appears to be the *Brassica Rapa*, variety  $\beta$  *oblonga*, of Linneus. This variety the Editor has cultivated, and can recommend as a most delicious vegetable: the seed was sown in drills, but would answer well sown broad cast. The roots remained in the ground all winter, very few of them rotting, (while the *Ruta бага*, or Swedish Turnip, rotted very generally,) and preserved their good qualities, without becoming pithy, until the month of May. The seed was obtained at Mr. M'Mahon's; it is sent to him from England, under the name, "French Turnip." *Editor.*

they are tender. Put them into a stew-pan, with a gill of veal gravy, two tea spoonsful of lemon pickle, one of mushroom cat-sup, a little mace and salt, and let them simmer, but not boil, for a quarter of an hour : thicken the gravy with flour and butter, and serve them up hot.

Another :—Prepare and boil the roots as before ; put them into a stew-pan with a little water, working in as much flour and butter, as will make it as thick as cream ; let them simmer five minutes, then place the stew-pan near the stove, to keep them hot ; just before you dish them, add two large spoonsful of cream, mixed with the yolk of an egg, and a little mace, beat very fine, shaking the pan over the fire for two or three minutes, but do not let them boil. Put white sippets of French bread round the dish.

Another :—Take the largest roots, clean as before, cut them in slices as thick as a crown piece, (or of a dollar) fry them till of a pale brown colour on both sides ; then put them into a stew-pan, with as much water as will cover them, to simmer for ten minutes ; add a large spoonful of Madeira or Sherry wine, the same quantity of browning, a few blades of mace shred, and two tea spoonsful lemon pickle, thicken the liquor with flour and butter, and serve them up with toasted sippets round the dish.

One great advantage attending the cultivation of this vegetable is, that it requires no manure. Any soil that is poor and light, especially if sandy, suits it, where it seldom exceeds the size of one's thumb, or middle finger. In rich manured ground, it grows much larger, but is not so sweet or good in quality.

If the season should prove dry, it will be necessary to water the beds regularly, till the plants have got three or four leaves, otherwise they will be destroyed by the fly.

---

### LARGE PUMPKINS.

Mr. Isaac Painter, baker, of Lancaster, planted in the summer of 1810, three pumpkin seeds, presented to him by a person from

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### LARGE PUMPKINS.

Mr. Isaac Painter, baker, of Lancaster, planted in the summer of 1810, three pumpkin seeds, presented to him by a person from

the state of Ohio—one seed only vegetated, the produce of which was as follows :

One pumpkin weighed	185 lbs.
One	170
The rest from	40 to 70 lbs.

There were seven pumpkins on the vine : the seed having been planted too late, the frost stopped their growth, otherwise it is probable that the increase would have been greater. The quality of the pumpkins was much superior to the common kinds ; those who eat of them, think them superior to the generality of squashes. It was remarked, that the pumpkins were late in setting, but after they grew to the size of a clenched hand, their increase was astonishingly rapid. The individual weights of pumpkins from the seed of the largest pumpkin, planted in the vicinity of Philadelphia, was unusually great. Mr. Griggs, of Whitehall, on the Wissahickon road, planted one seed, from which he obtained three pumpkins, one of these weighed 180 lbs. ; each of the other two weighed considerably above 100 lbs.

On the 19th September, 1811, a pumpkin was pulled, at the farm of Mr. William Rush, 8 Mile Point, New Jersey, on the Delaware, that weighed 176 lbs.

A single pumpkin seed, planted in the garden of Dr. Bogen, of Frederick town, Maryland, last spring, (1811,) produced as follows :

The two largest were formed in July, 1 of which measured round 8 feet, lengthwise 7 feet, and weighed 185 pounds. The other measured 7 feet round, 9 feet lengthwise, and weighed 155 pounds. The same vine bore also four others, which were not shaped until September, and had not come to perfection when the frost killed the vine. The largest of these weighed 111 pounds, the other three from 50 to 60, and the whole together upwards of 600 weight.\*

\* Frederick town paper.

Mr. John Wormly, of Cumberland County, Pennsylvania, planted last spring, (1810,) near the river Susquehanna, two pumpkin seeds, which produced twelve pumpkins—the weights of which are as follow :

No. 1,	.	.	.	108 lbs.
2,	.	.	.	100
3,	.	.	.	67
4,	.	.	.	95
5,	.	.	.	90
6,	.	.	.	88
7,	.	.	.	85
8,	.	.	.	83
9,	.	.	.	80
10,	.	.	.	75
11,	.	.	.	66
12,	.	.	.	65
Total,				<hr/> 1002 lbs.

Stacy Potts, Esq. Mayor of Trenton, (N. J.) was last year presented by a friend from Harrisburg, Pennsylvania, with two seeds of a large pumpkin, one of which he planted last spring in a poor piece of ground, and not being attended to, the produce was trifling; the other seed was planted in a good spot of ground in his garden, and being properly attended, bore eleven good pumpkins, weighing as follows :

No. 1,	.	.	.	178 lbs.
2,	.	.	.	157
3,	.	.	.	147
4,	.	.	.	142
5,	.	.	.	136
6,	.	.	.	113
7,	.	.	.	85
8,	.	.	.	83
9,	.	.	.	89

## LARGE PUMPKINS.

10,	.	.	.	69
11,	.	.	.	60
And several small ones,				105
				<hr/> 1364

One nearly as large as any of them, having been plugged by some mischievous person, rotted; this one promised to be as good as any of the rest, if it had not been injured, and would have caused the whole to amount to more than fifteen hundred pounds weight, from one seed.

Mr. Potts has used them in several different ways in the family, and finds them as good as others, either for house use or for cattle, &c.

The very nutritious quality of pumpkins, renders them an object of great consequence to every farmer; whether used as an article of diet in the family, or as food for cattle in winter. The superior excellence of the Ohio pumpkin, and the greater profit arising from their cultivation, when compared with the common kind, entitles that variety to particular attention. A journey of one or two weeks duration, to procure seed, would be amply repaid to any farmer, who would raise an acre of pumpkins weighing any thing like the above. It is well known, that the weights of the varieties in common use, are only from 15 to 50 or 60 lbs. The calculation of the difference in the produce, between the two kinds, will at once strike every farmer. The agriculturalists in the United States, do not sufficiently attend to the laying up a stock of juicy or green food, for the use of their cattle in winter and spring; nor are they sufficiently aware of the good effects which would be produced upon their stock by a free use of it. In England, turnips are the "*sheet anchor*," (for so they are called) of the farmer, and, as already stated, form one of the regular crops in every improving district, or where stock are kept. They justly remark, that feeding on hay entirely, is ruinous, and that such food cannot, moreover, give milk to females sufficient for the due invigoration of their young. The common turnips are first used, and when all consumed, the

Swedish turnip, called *Ruta Baga*, which keep better than the others, are then fed out. The latter require to be sown more early than the former. In the United States, turnips are not favourite food for cattle; and even pumpkins are fed away much too early in the winter. They do not indeed keep well after frost, but from the experience of the Editor, he can state, that if carefully collected when dry, not bruised, about four inches of the stem left on, and put away in places where the frost cannot affect them, or but partially injure them, they may be kept until late in the winter. Those that decay, should be used before the sound ones. Every four-footed animal will eat them, and the nourishment they give cannot be exceeded, either in quality or quantity by any vegetable. For suckling ewes, in particular, they are better than potatoes, which afford such rich nourishment, that if not alternated with more juicy food, the fine lacteal ducts of the ewe become stopped, and the lambs die. Several facts that have come to the knowledge of the Editor, leave no doubt with him as to this effect of potatoes. Horses eat pumpkins readily; some without any addition, but others require a seasoning of salt and corn meal sprinkled over them.

---

### PRODUCTIVE COW.

In p. 288 of Vol. 1, an account was given of the produce of milk and butter by a cow of the *Sussex* breed, in England, for two successive years. The following has been recently published\* as the produce of the 5th year, of this extraordinary and profitable animal.

Between the 3d of April, 1809, and the 10th May, 1810, a period of 57 weeks, the quantity of butter made from her was 762 pounds, which was sold at 1s. 6d. per pound, making

	£57 3
Skim milk, 4775 quarts, at 1d. per quart,	19 17 11

\* London Monthly Magazine.

Some new milk, amounting to	.	.	4	11
Manure, calculated at	.	.	3	
			<hr/>	
			84	11 11
Deduct expense of keep,	.	.	24	14 2
			<hr/>	
Clear profit,	.	.	59	17 9

The food and mode of treatment of this cow, are stated, in the Vol. and page above referred to.

---

### TO DESTROY GREEN LICE ON PEAS.

Mix fresh burnt lime and sand in alternate layers, round up the heap, and in 16 hours it will be fit to turn over, and if wholly slacked, it is fit for use. Then cast it over the pea vines with shovels, in a moist morning.

---

### GAPS IN POULTRY.

This destructive disease is said by Colonel <sup>D</sup>Mantague, a British farmer, to proceed from a new species of *fasciola* of a red colour, and about an inch long, which lodges in the trachea, (or windpipe) of chickens. In Devonshire, the remedy for the disease, is to mix the food of fowls with urine, in place of water: this prescription, he says, is very generally successful.

---

### SLABBERS IN HORSES—CLOVER WEVIL.

The opinion given in Vol. 1, p. 403, that the salivation in domestic animals, from eating the second crop of red clover, and of other grasses, proceeds from a small insect, is rendered probable from the following facts:

In the transactions of the Linnean Society of London, Vol. 6,

p. 142,\* William Markwick, Esq. states, that he had a field of eight acres of red clover, which he designed to save for seed, but having been told by his servant, that he had found the maggot in several of the heads, only half of the field was saved for seed. On examining the clover heads, he found in many of them several small white maggots or larvæ, and invariably placed on the outside of the base beneath the individual calyx of each floret, eating through the bottom, and thereby destroying the germen or rudiment of the future seed. They were similar in shape and colour, but much smaller than the nut maggot, having a white body, black head, and three small white scales on each side, which he supposed may supply the place of legs. These were not visible to the naked eye. He traced it through its chrysalis to its perfect state, by placing a number of the blighted heads of the clover in a box, carefully covered with gauze, and in 9 days he found, on opening the box, a great number of small black weevils running about it, and many of the chrysalids sticking at the base of the floret.

The damage done by the insect, may be estimated by a comparative view of two of his crops growing in two adjoining fields, and apparently equally good with respect to the growth of the plants, but very different in the produce of the seed.

In 1798, 9 acres of ground produced 33 or  $34\frac{1}{2}$  bushels of seed. In 1800,  $4\frac{1}{2}$  acres of ground produced  $7\frac{1}{2}$  bushels. Calculating the produce of  $4\frac{1}{2}$  acres of the crop of 1798, and comparing it with that of 1800, the loss was  $9\frac{1}{4}$  bushels, worth

	£23 2 6
Half of the crop of 1798, or $4\frac{1}{2}$ acres seed, sold for	41 17 6
That of 1800, for	18 15
	£23 2 6

No mention is made of the second crop of the clover of 1800, having produced a salivation in cattle, but the paper shows, that clover is subject to certain insects in England, and the plant may

\* London 1802.

be infested by others in the United States. It might probably tend to prove, whether or not the second crop clover in the United States, owed its salivating property to insects, if the heads were inclosed in a box, covered with gauze. The experiment is well worth the trial.

---

### METHOD OF PREPARING A BEAUTIFUL AND PERMANENT WHITE FOR WATER COLOURS.\*

By Mr. Grover Kemp.

Through the information of a chymist of the name of Hume, the public is already in possession of the facts, that a colour can be prepared from Barytes; and that this earth furnishes the only white for water painting, that never changes; which may also be mixed with any other colour, without injury; but of its mode of preparation, we have hitherto, I believe, remained entirely ignorant. This beautiful pigment, which not only surpasses in opacity and whiteness, every thing of the kind I have ever met with, but possesses the peculiar advantage of being permanent, is prepared by the following simple process:

Dissolve pure barytes, or the common native carbonate, in diluted nitro-muriatic acid; filter the solution, and add thereto as much carbonate of ammonia, previously dissolved in distilled water, as is sufficient to precipitate the earth, which may be separated by filtration; and, after repeated washings with distilled water, must be gradually dried by the heat of the sun, or a fire, and rubbed into a very fine powder, or made up into cakes for use. I decomposed some nitro-muriate of barytes with a solution of pure ammonia, but the precipitate was very inferior in colour to the above. An artist of acknowledged celebrity, who has used this white speaks very encouragingly of it.

\* From Nicholson's Philosophical Journal for Sept. 1811.

## CAUTION TO GUN-POWDER MAKERS.

Powder mills have often exploded without the possibility of knowing the cause of the accident : thus three successive explosions took place in the spring of 1803, at the powder magazine of Nongé, notwithstanding the precautions taken to prevent the fatal consequence. To explain the cause, the French government sent M. Lamaitre, inspector general, and M. Lechevin, commissary of salt-petre works, who found that charcoal in the lump had been used in the process, and a suspicion arose in their minds, that the attrition of the pieces of this ingredient might occasion ignition, they therefore tried the experiment, and produced several sparks. An order was accordingly given, that all charcoal employed in future, should be pulverized prior to its delivery at the magazine. It has been ascertained in France, that charcoal was capable of being set on fire by the pressure of mill-stones. Mr. De Caussigné appears to have been the first who observed this fact. Mr. Rohn, commissary of the powder mills of Essone, gives an account\* of the spontaneous inflammation of charcoal of the blackberry-bearing alder, that took place May 23d, 1801, in the box of the bolter, into which it had been sifted. This charcoal, made two days before, had been ground in the mill without showing any signs of ignition. The coarse powder that remained in the bolter, experienced no alteration. The light undulating flame, unextinguishable by water, that appeared on the surface of the sifted charcoal, was of the nature of inflammable gas, which is equally unextinguishable.

Mr. B. G. Sage, thinks that the moisture of the atmosphere, of which fresh made charcoal is very greedy, appears to have concurred in the development of the inflammable gas, and the combustion of the charcoal. It has been observed, that charcoal powdered and laid in large heaps, heats strongly.

\* *Annales de Chimie*, No. 35, p. 93.

About thirty years ago, Mr. Sage saw the roof of one of the low wings of the mint at Paris, set on fire by the spontaneous combustion of a large quantity of charcoal, that had been laid in the garrets.

M. Malet, commissary of gun-powder at Pontailler, near Dijon, has seen charcoal take fire under the pestle. He also found, that when pieces of salt-petre and brimstone were put into the charcoal mortar, the explosion took place between the fifth and sixth strokes of the pestle. The weight of the pestles is 80 pounds each; half of this belonging to the box of rounded metal, in which they terminate. The pestles are raised only one foot, and make 45 strokes in a minute.

In consequence of the precautions now taken, to pound charcoal, brimstone, and salt-petre separately, no explosions have taken place; and time is gained in the fabrication, since the paste is made in eight hours, that formerly required four and twenty.

The goodness of gun-powder depends upon the excellence of the charcoal used in its composition. The greatest care should be taken therefore in its preparation.

*Editor.*

#### ERRATA—Vol. II.

- Page 54, line 4th, for "strong," read *large*.  
119, line 17th, between "has" and given, insert *not*.  
— line 22d, for "wood," read *woud*.  
217, note—line 3d, for "Their," read *This*.  
242, line 7, for "rolling," read *rotting*.  
251, line 16, for "is," read *sinks wet*.  
— in the note, for "crop," read *cross*.

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